THE
NAVIGATOR:
SHEWING AND EXPLAINING
All the Chiefe Principles and Parts
BOTH
THEORICK
AND
PRACTICK,
That are contained in the famous **Art** of
NAVIGATION.
WITH
A NEW AND ADMIRABLE WAY OF
Sayling by the Arch of one of the greatest Circles.

Containing excellent Tables most
exactly Calculated, shewing the true Proportion of all *Parallels*
in respect of the *Meridian*.

With the proper Phrases used in working of
a Ship according to all weathers.

With *A Word of Advice* to all Sea-men not to medle with the Plaine
Charts used in our time, their deceipts discovered, and a way to prove the
projection of any Plain Chart; how to marke the Log-line according
to a true Degree in the Meridian.

The third Edition corrected and enlarged.

By Captain CHARLES SALTONSTALL.

LONDON,

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TO

THE RIGHT HONOURABLE
THOMAS,

Earl of ARUNDEL and SURRY,

Lord high Marshall of England, Knight of the
Noble Order of the *Garter*, and one of his
Majesties most Honourable Privie Councel.

RIGHT HON.

WHEN a right Noble disposition is once generally discovered, it emboldens men that are meere Strangers, to presse into their presence, provided their errants are onely concerning vertuous Actions, which motive hath made these rude lines voild of all Rethoricke, runne with such haste to your Lordships hands, intreating for a favourable acceptance of a few experimental Conclusions, performed in the admirable Art of NAVIGATION, *by one that is as much a stranger to your Lordship, as I am to the Land and my Kins-folkes, many long Voyages having banisht mee from the remembrance of them both; so that I may justly affirme, I am scarce known to either of them, except now by reading my Name, they rub up their remembrance and find me revived, who have layne a long time raked up in the embers of oblivion. Howsoever it happen in that respect it is a matter very indifferent to my mind; for I onely desire, that these my Practices may prove pleasing to your Lordship, which although they are delivered in a blunt phrase, I assure you (Right Honourable) will speak the plain Truth, otherwise they should not dare to desire such Noble protection, if they could not deserve and merit that which is most esteemed amongst vertuous minds. Therefore I doe in a manner assure my selfe they will gaine your gracious aspect, which is too great a reward to let fall upon the first-born of my braine, and so will bind me perpetually to study, how to illustrate my present performance, that it may ever gaine. Your Honours good will.*

Your Lordships, to Command
in any service:

CHARLES SALTONSTALL.

To all Generous and Industrious Sea-men.

Kind Companions:

Could not chuse but present these few lines to your favourable acceptance, before you proceed to take a farther view of the following Work, that none might hereafter mistake my intent, and imagine where ignorance is openly pointed at, that I meant any of you in particular: For Industry and Art, are both sufficient Bucklers to shield you all sure enough from any such danger. But you know there is a certain kind of Creature, crept into the confines of most warlike Ships, whose rare and illitterate allegations are ever absolute against the Rules of Art, and all those which bring about their Conclusions according to such directions; because they are clean contrary to their constitutions. If such men as they snuffe up Pepper, and so fall a sneezing out their malice against the matter, which in no wise they are able to mend, the distaste will give me no discontent, for their palates cannot relish the excellent rules of Reason; therefore I am certain will suck out nothing but the sowre sauce, which will make them vomit up their venome, bequeathing all the rest to the intelligent Artists, men of another temper, whose tastes are able to distinguish what variety of delicate faire Fruits they are freely feasted withall. Their goodnesse I doe not doubt, but time will so well discover, that some gratefull acknowledgement shall be powred upon the first Planter, howsoever it fortune, I doe not desire to find favour through a flattering Epistle, presuming the ensuing matter must merit that, or else I have much mistook the marke, and took a great deale of paines to little purpose. So farewell.

Yours, how you will.

Charles Saltonstall.

A word of advice to all my kind friend, and loving Companions, the Industrious Sea-men of this English Nation.

THE Epistle now placed herein this Book next before my word of *Advice*, I writ unto you some yeers since wherein I suppose you saw I went not about to flatter grofs ignorance yet openly pointed at no man in particular, I shall still endevour to use the same Scale in the following difcourfe, therefore if any one will needs have it that by this word of *Advice* I mean them in particular, truly they will but proclaim their owne follies and make the world take notice of their weakneffe, that Dull Ignorance the grand enemie to all Arts, muft not at any time be difcourfed of, but prefently they apprehend it can Concerne no body but themfelves, now if any fuch Shallow-brains (grown full ripe to be cut off the Simples) fret and fume beyond all reafon, I muft tell them I care not a rufh, being fully refolved to advife all my kind friends, and loving Companions the Sea-men of this Nation of fuch things as hath a long time hindred the growth of the famous Art of Navigation without refpect of perfons, how old and ignorant fo ever they are that hath abufed, and deluded them with un-found and deceitfull directions.

It is now 47 yeers fince Mr. *Edward Wright* learnedly difcovered the Abufes of the Sea-Chart then in ufe delineated with equal degrees of Latitude and Longitude in all places, and

B   there-

thereupon artifically calculated Tables, for the true graduating a Meridian Line in degrees, of un-equall parts still encreasing as you draw neerer the Poles in due proportion as the degrees of Longitude in each parralel upon the Globe decreaseth, he also calculated Tables for the true drawing the Helix-phericall Rumbs, by which means there was another Chart answering in proportion to the Globe artifically contrived by our Learned Countrey-man, frequently called, *Mercators projection*: But Mr. *Wright* saith in his Preface, that the way how these things were drawne, he learned not of *Mercator* or any man else, only *Mercators Mappe* brought them first into his minde, Therefore I suppose the Sea-men of the *English* Nation ought in the first place gratefully to acknowledge the endeavours of our truly Learned Countrey-man Mr. *Edward Wright* who was no wayes inferiour to *Gerardus Mercator* in all Mathematical Arts, and sciences. Now in M. *Wrights* time only these two sorts of Charts were known to our *English* Nation & the errours of the first so apparently proved by him that it became every plaine Sailers discourse & work to demonstrate the reasons, and to prove the increase of Errour as the Navigation was more Northerly or Southerly, which gave good hope that the famous Art of Navigation would in short time grow to very great perfection, amongst practical Sea-men, and so assuredly it had done if the *English* Sea-men had not long since been strangly deceived by a third sort of plain Charts slily brought in amongst them by whom I know not: but am certain it is the most notorious delusion and grand deceit that ever was contrived to hinder the growth of the famous Art of Navigation, and hath infected the Nation above this 27 yeeres, as by my own practicall experience at Sea I am able to testifie, Now that all Sea-men may more clearly understand after what manner they have a long time been abused by this third sort of plain Charts, I shall desire them all carefully to observe and per-use this following *Diagram*, and it will undeniably discover the natures and qualities, both of that sort of plain Chart used in Mr. *Wrights* time as also this third sort now used in our time.

A

A Diagram clearly discovering both the Nature and quality of the plain Charts used in Mr. Wrights time, and also of those plain Charts used now in our time.

B   150 le.   F   450 le.
Æquinoctiall   A
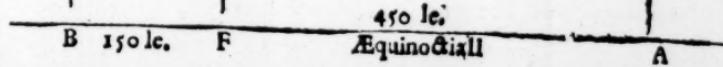
The Projection of the plain Charts used in *Mr.* Wright's *time.*

IN this *Diagram*, let AB represent two Islands lying right under the Equinoctial line distant from each other 30 degrees of Longitude, or 600 leagnes concurring in that place directly with the Globe, and let C D also represent, two Islands lying in the Norrh Latitude of 60 degrees distant from each other, also 30 degrees of Longitude which by this Projection must still be accounted 600 leagues which is more then the true distance betwixt D and C, scituated according to the Globe by 300 leagues; Now I say these four Islands A B C and D are duly scituated according to the plain Charts used in Mr. *Wrights* time having equal degrees of Latitude and Longitude in all places, according to the degrees in the Equinoctial and Meridian, and so maketh the distance betwixt the Islands D and C, in the Latitude of 60 degrees double to the distance betwixt those Islands if they were scituated upon the Globe.

The Projection of the plain Charts, used now in our time.

IN this *Diagram* again let A and D be two Islands lying right under one Meridian A scituated under the Æquinoctial and D in the Latitude of 6 degrees as before, then let the Island at B also scituated under the Equinoctial exactly true in the former Chart, according to the Globe distant from A 30 degrees or 600 leagues, be placed at F under the Equinoctial according to the rate of 30 degrees of Longitude in the parralell of 40 degrees, each degree of Longitude in that Latitude,

tude being about 15 leagues, therefore the distance now betwixt A and F can be but 450 leagues, and so much is the Error by this Chart from the true distance betwixt A and B in the Equinoctial, then let the Island at C in the Lat. of 60 degrees distant in the former Chart, also 30 degrees of Long. or 600 leagues according to the degrees of Longitude in the Equinoctial which is more then the Globe by 300 leagues be placed at E 30 degrees distant from the Island D, according to the parallel of 40 degrees, where 15 leagues makes one degree of Longitude as before, therefore the distance now betwixt D and E must be 450 leagues, which is 150 leagues more then the true distance betwixt D and C, scituated upon the Globe; Then I say, these four Islands A B C D, now represented in the Diagram by the letters A F E D, are againe duly scituated, directly according to the plain Charts used in these times; having also equal degrees of Latitude and Longitude in all places, according to the Equinoctial and Meridian, as the former hath, yet in Longitude concurring with the Globe in no place, but only about the Parallel or Latitude of 40 degrees; And so by this abominable delusion, maketh the distance betwixt A and B in the Æquinoctial, to be lesse then it should be, by 150 leagues, and the distance betwixt D and C, in the Latitude of 60 degrees, to be more then it should be by 150 leagues, all which evidently appeareth in the former Diagram.

A true and ample Explanation how Practical Sea-men have been a long time abused by these Deceitful Plain Charts, the Grand enemy to the famous Art of Navigation.

I Suppose practical Sea-men until now did not cleerly apprehend what a sly trick, hath been put upon them, by the

Pro-

Projector of this sort of pernicious Plain Charts. whose name I know not, which if I did, I assure you, I would not spare to name him, and set as black a Character upon him, as the merit of his unworthy action deserveth; It seemeth cleer to me, when Mr. *Wright* 47 years since, had learnedly discovered the Errors of the Plain Charts then in use, and given direction for the making another true Chart, now commonly called *Mercators* Projection, this deceiver did not long after begin to sow his Tares amongst the cleer Wheat; and so projected this plain Chart, concurring in Longitude with the Globe, only about the Latitude of 40 degrees, and no where else, which weak contrivance, being not well discerned by Practical Sea-men many were deceived, and took this Plain Chart, to be that which was used in Mr. *Wrights* time, and thereby not discerning the hidden deceit, now cleerly discovered; began to stumble at Mr. *Wrights* learned indeavours, supposing he mistook the mark, when he affirmed the Error in Longitude by the Plain Charts, was still greater, as the Navigation was more Northerly or Southerly; For say they, let the difference of Longitude betwixt *Virginia, Marie-land,* or the South parts of *New England,* and all the Coast of *Portugal,* from Cape *Finister,* to Cape St. *Vincents,* be taken into consideration, and the Longitude betwixt those parts of *America,* and the Coast of *Portugal,* will reasonable well concurre with the Longitude upon the Globe, therefore how doth the errour in Longitude encrease in those Charts, as the Navigation is more Northerly, or Southerly, as Mr. *Wright* would have it, when about the North latitude of 40 degrees: the Longitude betwixt these places in *America,* and the Coast of *Portugal,* (being so great a distance as it is,) differeth no more from the Longitude, by the Globe, and so by this scurvie trick put upon them, and for want of taking notice, until now that these Plain Charts were true in Longitude, only about the Latitude of 40 degrees, and no where else, many Practical Sea-men have a long time been notoriously deluded; In all their Navigations which have not hapned to be about the Latitude of 40 degrees, for by these pernicious plain Charts, the errours in Longitude now encrea-

seth,

feth, as the Navigation is more Northerly or Southerly from the Latitude of 40 degrees; So that now at the Æquinoctial the errour in Longitude is full as great, and the same as in the Latitude of 60 degrees; Whereas by the Plain Charts in Mr. *Wright*'s time the Longitude at the Æquinoctial concurred directly with the Globe, and no where else, therefore the errour in Longitude increased in those Plaine Charts, as the Navigation was more Northerly, or Southerly from the Æquinoctial, towards either of the Poles, as Mr. *Wright* affirmed, and so in the same manner ought these deceitful Plain Charts, to have been delinated and described that the errours in Longitude, might have cleerly appeared in all parts and places, & not been thus obscured or mitigated in any Latitude, the most mischievous and wicked practice that ever was invented to ruine Sea-men, and hinder the growth of the famous Art of Navigation; For if the Plain Charts now used, were the same as in Mr. *Wrights* time, the errours of Longitude still increasing towards either of the Poles, the apparent errours in Course, Distance, and Departure, are speedily rectified and reduced into the true proportion of the Globe, several wayes, either by Arithmetical calculations, or by most facile and familiar protractions performed by Scale and Compasse, which rectified Saylings, I have taught many expert Practical Sea-men; whose industrie and experience (the most competent Judg) hath confirmed them the best way of Sayling, that ever came amongst them, but if any of these expert Practical Sea-men should indeavour by these Rules, to rectifie those pernicious Plain Charts, which corcurre in Longitude with the Globe in the Latitude of 40 degrees, and no where else they would multiply and increase the errour; So that all these Practical Sea-men that will make use of these notorious Plain Charts (which indeed at this day are very many, the more is the pity,) must resolutely lay their reputations, Ships, Goods, Lives, and all at stake on'y upon the pricking these Charts, (as it is called at Sea) without any other Art, hope or help, which will as surely bring them to shame if not confusion, as Artificial

tificial Sayling upon found principles will gaine them credit and prefervation ; So having now cleerly difcovered to all my kind friends, the Englifh Sea-men, how exceedingly they have a long time been abufed and deceived, by this fort of Plain Charts ; I hope they will now all take notice of them, and fuffer them no longer to be infnared by their fine painted faces, full of flattering falfe directions , but will rather root them out of remembrance , and utterly abhor their deceits , the fhame and hinderance , of the famous Art of Navigation, and hereafter own no other Plain Charts, but fuch as hath the degrees of Longitude and Latitude in all places equal, and directly true in Longitude, according to the Globe at the Æquinoctial, and no where elfe , otherwife that Artificial Chart contrived by Mr. *Wright* now commonly called *Mercators* Projection , becaufe by both thefe Charts the Practical Sea-man may faile and performe his Navigations , to all parts of the World very artificially , For I can, and do daily, teach many Practical Sea-men to rectifie thofe common plain Charts ufed in Mr. *Wrights* time , in Courfe, Diftance, and Departure, with fuch fpeed and plainnefs , both by Arithmetical Calculations , and Geometrical Protractions , that the leaft and loweft capacity that can now but onely prick down his Courfe , Diftance, and Departure , upon the former deceitful Plain Charts; fhall with the like facility and plainneffe, rectifie his Courfe , Diftance, and Departure into due proportion , according to the Globe , which Protractions and Calculations , fhall concurre with the Courfe , Diftance, and Departure found by *Mercators* Projection, but performed with more expedition and leffe fear of miftaking , then in the wayes ufed in pricking down the Courfe , Diftance , and Departure upon thofe artificial Charts commonly called *Mercators* Projection.

How

Now you may facilly proue any plain Chart, whether it be of this deceitful projection or not? If from the latter best Globes you take out the true Longitude of any two common known places both scituated and lying under or neer the Æquinoctial; As also the Longitude of two known places sī uated and lying in or neer the Latitude of 60 degrees, which Longitude so taken, may be kept in readinesse only for this purpose.

For if in any plain Chart you find the difference of Longitude betwixt the same two places, under or neer the Æquinoctial to be lesse then by the Globe so much as they are lesse is the errour, and then be sure they are these deceitfull Charts, but if the Longitude betwixt the said places, be equal to the Globe, then they are the Plain Charts used in Mr. *Wrights* time.

And againe, if the difference of Longitude betwixt the same two places in the Latitude of 60 degrees, by any Plain Chart be more then by the Globe, but not directly double to the distance upon the Globe, so much as they want of double is the errour, and then be sure they are the deceitfull Charts, but if the distance betwixt the said two places is directly double to the distance upon the Globe, they are those plain Charts used in Mr. *Wrights* time.

So now if two places, under the Æquinoctial did differ in Longitude 44 degrees by the Globe: which is 880 leagues, the deceitful Chart will shew their difference of Longitude to be but 760 leagues, which is two little by 120 leagues: And if the two places in the Latitude of 60 degrees, diff r in Longitude 44 degrees by the Globe, which in that Latitude is 440 leagues, the deceitfull Charts will shew their distance there to

G   be:

be also 760 Leagues, which is now too much by 120 leagues, therefore it is thus undeniably proved that the errour in Longitude upon these deceitful Plain Charts, is as much and the same at the Æquinoctial, as in the Latitude of 60 degrees, and no where coming neer the truth, but about the Latitude of 40 degrees: a most insufferable deceit, which I hope you will all now take into your serious considerations for the general good, and Advance of Navigation.

The

THE
NAVIGATOR.

CHAP. I.

The Division and Description of the whole Art of Navigation.

HE admirable Art of *Navigation*, is that which produceth most certaine and infallible Directions, how you shall sayle a Ship the most compendious Course betwixt any two places that are never so farre Distant, if there be Sea or water sufficient for the Ship to swimme through : which knowledge is gained by getting the true Understanding of these two principall parts ; Namely, the *Theoricke*, and the *Practicke*. For the Theorick will fully informe you of the composition of the *Spheare* in generall, and in particular of the Figure, Number, and Moti-

ons

ons made in the Heavens, chiefly of the highest moveable,
called (*Primum mobile*) and likewise of the first, fourth, eighth
and ninth Heavens; the Theoricke will also informe you how
the Elements are disposed. With their quantities, and scitua-
tions, especially in the composition of the earth, and waters,
which make one absolute round body, with the nature and use
of the Circles which are supposed to be contained in that
Spheare, if you doe nor endeavour to get this knowledge, you
cannot desire the name of Navigator : The Practick part is
properly placed upon the making and using of divers Instru-
ments, as Crosse-staves, Back-staves, Nocturnals, Planispheares,
instruments for the Moone and Tydes, with divers others. Yet
there is one certain Composition more rare then all the rest
in the Practick of Navigation, which hath ever been omitted
by all men that have writ of the Art, And that is, the un-para-
leld Fabrick of a gallant Ship, whose way of working, ruling,
guiding, governing, and constraining to performe the expert
Navigators pleasure in the Sea, hath at no time untill how
been explained by any Pen, But I could not let it passe any
longer, because I knew with proper phrase now to performe
it, which perchance hither-unto hath hindred it from the pub-
like view, howsoever it hath happened I know not, but, me
thinks, the divers Navigators which have writ severally of the
Art, should some of them have remembred before this time
to try how truely and lively they could have layd forth their
Skill in controlling, guiding, and working a Ship according to
all weathers at Sea, by the expression of their pen : but I trust
they will all pardon me for taking notice of their over-sight,
if they will not. I assure him that thinkes himselfe the most
sufficient that I doe not feare hee should draw forth a second
description to make the matter appeare more lively in a lesse
Compasse.

CHAP.

CHAP. II.

The Practicke part of working a Ship in
all Weathers.

FOR that part of Navigation which is performed
by the practicall knowledge of working a Ship
in all weathers at Sea , it is impoſſible for any to
preſcribe rules , or give demonſtration by words
to thoſe which are altogether ignorant of Marine affaires, that
they may reape any benefit or knowledge by it , although in-
deed, that whole Practicke part may be compoſed and delive-
red in proper Sea-phraſes according to each ſeverall materiall
belonging and appertaining to a Ship compleatly rigged, with
the uſe of each ſeverall Rope in working and trimming ſayles
at Sea ; But I pray , who would or could poſſible apprehend
the reaſon of ſuch a demonſtration except an experienced Mar-
riner, who will give you as little thanke for your labour in ta-
king paines to advertiſe him of thoſe things which all his life-
time he hath bin brought up to , as if you ſhould goe aboard a
Ship and ſhew the Maſter which is the Mayne bow-lyne , but
becauſe all Arts and Sciences, are divided into two chiefe parts
or principals, namely, the Theorick and Practick, and in regard
it is impoſſible, for any to be compleat , without he hath attai-
ned to the true knowledge of them both being inſeparable
companions which ever waite upon perfection. Therefore I
could not now command my pen to paſſe any further forward,
before it had firſt plainely expreſſed the proper way
of working a Ship in all weathers , that it might pre-
vent the cenſure of all ſuch, as I am certain will bee
very curious in inquiring , whether I may not bee found
lame in that Limbe , and ſo like themſelves ſhould appeare
moſt imperfect, (for with griefe I ſpeake it) this Noble Art
of Navigation had never more maimed and decrepit fel-
lowes (preferred through favour and fortune) ſo that now

a dayes

a dayes let one come aboard a tall Ship at Sea, and it will be very rare to find Ignorance out of the round-house, but commonly better Marriners and more sufficient men afore the Mast, which are turned Hawle-Bowlings through the averfnesse of their fates, I should be very glad to see a more equall Ballance used, for the furtherance of the industrious and incouragement of deserving men, For, if this insufferable partiality should be of any long continuance, I feare in short processe of time, the compleat Mariner will very hardly be found aboard any Ship although you search, Fore, and Aft, to the great dishonour of this famous Isle, which hath so long deservingly held the superiority of all other parts of the whole World, for breeding and bringing forth Famous Navigators. The *Hollanders* already beginneth to have us in Contempt, saying, he is farre afore us, both for Ships and sufficient Mariners, but for the last, it may be soone answered, had not the former un-equall ballance enforced our expert Saylers to seek if Fortune would be more favourable amongst them, they had not been at this day in such a flourishing height, but swift Time is subject soone with his silent course to steale that out of remembrance, and so I doubt they will exceed us indeed, to our Nations dishonour. I will not draw forth this digreffion to any longer discourse, least my Rethoricke should not relish in the Eares of all men, but will now returne, to this Practick part formerly expressed, that it may appeare in proper Sea-phrase, how a ship compleatly Rigged should be worked both by and large in Faire weather and Foule, not expecting that any may reape knowledge by it, but only that Mariners may censure, for some I know being a little touched will say (as their common phrase is) if they had me at sea, and turned me three times round, all my bescribed rules will be to seeke, but let them know (no) not if they turned the ship threescore times round, and let it blow-high, blow low, but I will worke the Ship as well in all assayes as ever they did, therefore to prevent such calumnie, let all men consider this Practick part, in briefe following.

My Anchor is away.

THe winde is Roome, let fall your Fore-ſayle, heave out Fore-top-ſayle, heave out Main-top-ſayl, hoice up Fore-top-ſayle, hoice up Maine-top-ſayle, looſe Sprit-ſayle, heave out Mizen-top-ſayle, ſquare your Sprit-ſayle, a brave gale, let us have her in all her Canvaſſe, heave out Sprit-ſayle, Top-ſaile, Fore-top-gallant-ſayle, Maine-top-gallant-ſayle, hoiſe up your ſmall-ſayles, hawle aft your fore-ſheats, I keep my Mayne-ſayle furled, becauſe I hold if your Fore-ſayle and Fore-top-ſayle be good ſayles, that the Ship maketh better way now, then if her Mayne-ſayle vvere dovvne, vvhich vould becalme her Fore-ſayle, and Fore-top-ſayle, and the Ship ſteereth beſt vvith her Head-ſayles. I have of purpoſe omitted the cleering each ſeverall Rope, novv at my ſetting ſayle, onely you muſt imagine, that the Sheats are all havv-led home, and the yards hoyſed up, and then you have her compleat, under ſayle right affore.

A freſh-Gale.

THe vvind blovveth freſh, havvle dovvne your Fore-top-gallant-ſayle, havvle dovvne Maine-top-gallant-ſayle, in Sprit-ſayle-top-ſayle, let goe Sprit-ſayle-top-ſayle, Sheats, havvle home his Clu-lines, in Fore-top-gallant-ſayle, in Main-top-gallant-ſayle, in Myzen-top-ſayle, let goe Top-gallant-ſheats, caſt oft Top-gallant bovv-lines, havvle home Top-gal-lant Clu-lynes, the Myzen Top-ſayle is in, and ſo is all the reſt of the ſmall ſayles.

A Scant-Wind.

THe vvinde Scanteth, veare-out ſome of the weather Sheat of the Fore-ſayle, let goe your vveather-braces, top your

your Sprit-fayle, loofe Mayne-fayle, the wind vereth for-
ward) get too your Fore-tack, caft off your weather-fheate,
let goe your weather-Brafe, vere out fome of the lee-Sheate,
let fall Maine-fayle, get too Maine-tack, caft of Maine-brafe,
and Maine-top-fayle, hawle aft Maine-fheate, the winde is
Sharpe, in Sprit-fayle, fquare Sprit-fayle-yard, let goe Sprit-
fayle Sheates, hawle up Sprit-fayle Clu-lynes, get Maine-bow-
lyne, in Block, hawle forward Maine-bowlyne, hawle Maine-
top-fayle Cowlyne, hawle tought, Fore-bowlyne, and Fore-
top-fayle Bowlyne, hawle aft Maine-fheate, hawle abroad
Myzen, fet your Lee-braces, and keep her as neare as fhe
will lye, here you have all your fayles, Trim'd fharpe or by a
wind.

A Stiff Gale.

THe wind blowes Frisking fettle downe your Fore-top-
fayle, fettle Maine-top-fayle, (much wind) hawle downe
Fore-top-fayle, hawle downe Maine-top-fayle.

A hard Gale.

IT bloweth hard take in our Top-failes, let goe your lee-
Brafes, and caft off your Bow-lynes, brafe your Weather-
Brafes, and foill your Sayles, let goe Top-fayle Sheats, hawle
home Top-fayle Clu-lynes, the fayles are furfed fquare your
Top-fayle yards, here have you the Ship brought into her
courfes of low-fayles.

A Storme.

IT bloweth extreame, and like to over-blow, fee that your
Maine-Hail-yards be cleere, make all your geere, cleare to
lower the Maine-yard, hawle downe the Myzen, caft off Top-
faile Sheats, Clugarnets, Buntlynes, Leechlynes, Lifts, and all
your other geer, (and Lower) bring the yard downe, hawle
to,

to the Capsten, the yard is downe, get the Saile together, and Furle it sure, make fast the yard for Traversing.

A grown Sea.

THe Sea is much growne, we make foule weather, look our Gunnes be all fast, it is better Spooming, put the Helme a weather, and mind what is said, right your Helme, let rise Fore-tacke, settle our Fore-yard, the Fore-saile giveth way, (lower a Mayne) hawle the Sayle into the Ship and loose it from the Yard, get too the Fore-Bonnet, make all cleare, and hoise the Fore-yard, here have you the Ship brought from all the Canvasse to a Fore-bonnet, spooming before the Sea.

A fierce Storme.

STarbord, Hard up, Right, Port hard, more hands (he cannot put up the Helme) the Sea breakes dangerous, have a care what is said, and stand stoutly to the Helme, shall we get down our Top-masts, no let all stand, the Ship is the wholsommer, and hath better way through the Sea, for their being a loft, (if you have Sea-roome, it is never good to strike your Top-masts either under the Sea or before;) thus much for handling the Ship By and Large, in Faire-weather and Fowle, now a word or two of turning to Wind-ward.

To turn to Wind-ward.

MY Course is N. and the Wind is at N. E. get your Starboard-Tackes aboard, cast off your weather Braces, brace upon your Lee-Brases, and hawle forward by your weather Bow-lines, hawle tought all your weather Bow-lines, and set in your Lee Brases, hawle abroad Myzen, and keep her full, and By, as neer as she will Lie, *How wind you*, N. N. W. aquade winde (no Neer) hard no neer, the wind

D   veareth

veareth forward, we fhall have a wefterly wind, *How wind
you*, W. N. W. hard no Neere, *How wind you*, S. W. (make
ready to goe about) we fhall lye our courfe the other way
(*Ready, Ready*) no Neere, give the Ship way that fhe may
Stay, (a Lee the Helme) veare out fore Sheate, caft off Lee-
Brafes of your Fore-faile, and Fore-top-faile, brafe upon the
weather Braces, (the Fore-fayle is a back Stayes) hawle about
Maine-faile, let raife Maine Tacke, caft off your Larboard-
Braces, let goe Maine Bow-line, and Maine-top-faile Bow-
line, hawle forward by Larboard, Maine Bow-line and Main-
top-faile, brafe upon Starboard, Maine Brafe and Maine-top-
faile, get too Maine-Tack: and then hawle aft Maine Sheat, let
rife Fore-Tack, veare out weather Sheat, get too Fore tacke,
let goe Fore-Bowlyne and Fore top-fayle, hawle aft Lee Sheat,
hawle tought Maine Bowline and Maine top-fayle, hawle
tought Fore Bowline and Fore-top-fayle, fet in Lee Brafes,
Fore and aft, and the Myzen fhifted, keep her as neere as
fhee will Lye, no Neere, *How wind you*, N and a weather,
no Neere, keep her full, the wind is at Weft, keep her as
neere as fhe will Lye. *How wind you*, N .N. W. no Neere, veare
out fome of the Maine Sheate, and eafe your Lee-Brafes, keep
your courfe, (the wind is broad) veare out fome more of your
Maine Sheat, let goe your Bow-lines, and Lee-brafes, the wind
is *Quartering*, let rife your Fore-Tack, hawle aft the weather-
Sheat abaft the Anchor Stock, brafe upon your weather Bra-
fes, hawle up your Myzen and loofe Sprit-fayle, a brave gale,
the wind is all aft, let rife Maine-tack, hawle aft Maine-fheat,
fquare Sprit-fayle and all the reft of our fayles; here have you
the Ship in all her Canvaffe again, Steering right before the
wind as fhe did at the firft fetting fayle, having been worked
in all manner of weather: and with all forts of winds; there-
fore I will onely proceed concerning how the Man-of-Warre
ought to be worked, in all affayes, and fo will leave you the
Practicke to cenfure.

A

A *Man of Warre.*

OUr Man of Warre is compleatly Rigged, and fitted with all manner of materials, a choice crew of Sea-men aboard, and now lyeth at *Hull* in a good Latitude, dayly expecting that a faire Fortune will appear within her Horizon, the day breakes, bravely (up youths into the Tops and look abroad now at Sunne-rising) look to the Westward, if there be no plyers that are Nipt with the Easterly wind, (*A Saile, a Saile*) faire by us (how stands she) it is one that is plying to wind-ward, she stands with her Larboard Tackes aboard, O then she lyes, to the Southward with the Stream a brave Chase) we see her here upon the Decks, set her by the Compasse (how beares she) due S. W. a good man to the Helme, let fall Fore-sayle, get Larboard tackes a board, down Main-saile, heave out Fore-top-saile, heave out Main-top saile, hoyse up Fore-top-sayle, hoyse up Main-top-sayle, let fail Sprit-saile, out Main-top-gallant-sayle, out Fore-top-gallant-sayle, out Maine-top-gallant-sayle, hoyse up our small Sayles, hoyse up your Mizen, heave out our Myzen-top-sayle, have a care of your hand at the Helme, (keep her thus) well Steer'd, the Ship makes brave way through the Sea, and we raise her apace, if she keep her course we shall be up with her within two glasses, (Starboard) keepe the chase open with the leeth of the Fore-saile, well (Steered) keepe her thus, come aft all hands, the Ship will saile better by a Top-saile, for she is too much by the head, fit all still that the Ship may runne true through the Sea, it is a great Ship (no force) she hath the bigger hold, and carries more goods, (Port) the chase is about (Port hard) let rise Maine-tacke, let rise Fore-tacke, brace upon your Larboard braces, get too Starboard Maine-tacke, and Starboard Fore-tacke, cast off all your Starboard braces, (steady) right your Helme (well steer'd) the chase clings up close to the wind, keepe her open under our Lee, Gunner see that all

our

our Gunnes be cleere, and that nothing pester our Deckes, for we shall be straight up with her (Starboard) the chase payes away , more roome (Starboard) veare out some of the Maine Sheate , and Fore Sheate, cast off all your Larboard braces, (steddy,steddy,) keep her thus, well steered, the chase stands roome, her Sayles are trimm'd before the wind, (Starboard hard) let rise Maine-tacke , let rise Fore-tacke , hawle aft Maine-Sheats , hawle aft Fore Sheates , we have a Sterne chase , hawle up one Maine-sayle in the Brayles , the Ship will steere the better with her head Sayles , and will have quicker way through the Sea , we fetch upon her hand going , the chase hawles up his Maine-sayle and furles it , she puts abroad her waste cloaths , she will fight with us before the wind , (come up alow yongmen) and furle our Maine-sayle , Slyng our Maine yard , with the Chaines in the Maine-top , Slyng our Fore-yard , put abroad our waste cloaths (is all things cleere below) leave not so much as a Spun yarne amongst our Gunnes, downe with all Hammacoes , and Cabbins that may hinder or hurt us , Gunner have you all your geare in a readinesse , is there store of Cartrages ready fill'd , all manner of shot at the Maine-mast , Spunges, Rammers , Ladles , Primming Irons , and Primming hornes, Lyntstockes , Wads , and water sufficient for the severall quarters , be sure that none of our Gunnes be cloy'd , and when we are in fight , ever load with Crosbar and Langrell , alwayes observing to give fire when the word is given , see that there be halfe Pikes and Javelings in a readinesse , and that all our Murtherers and Stockfowlers , haue their Chambers fill'd with good Powder and bagges of small Shot to loade them , that if we should be laid aboard we may cleere Decks , we are almost up with our chase , she is full of men it is a hot Ship, but she is deep and very foule (come chereely my hearts) it is a Prize worth fighting for , the chase takes in her small Sayles,up aloft youths, take in our Top-gallant-sailes,in Sprit-saile-top-saile,in Mizen-top-saile,take in our Sprit-saile,and bring the yard alongst-ships,she puts abroad her colours, it is the Ragged Staffe, boy up & put abroad St. *George*

his colours in our maine-top ſtep aſt at hand and put abroad
our bloudy Ancient , ſhe ſettles her Top-ſayles , we are within
ſhot , let all our Gunnes be looſe in the Tackles , and the
(Port) all knokt open that they may runne out when the
word is given , up Trumpet aud haile our Prize , ſhe anſwer-
eth us againe with her Trumpet , hold faſt Gunner , do not
give fire untill we haile him with our voices (Port) edge
towards him , he fires his broad ſide upon us (what cheere my
Mates , is all well betvvixt Deckes , yea , yea) only we are
rackt through and through (no force it is his turne next
but give not fire at any rate untill we are vvithin Piſtoll ſhot.
(Port) edge tovvards him , he plyes his ſmall ſhot , hold faſt
Gunner (Port) right your Helme, vve are cloſe aboard (Star-
board) give fire Gunner , anſvver him in his ovvne Languags ,
he gaules us vvith his ſmall ſhot , Gunner clap in ſome caſe ,
ſhot into thoſe Gunnes which you are novv a loading , vve are
ſhot a head, he lyes broad of to the South-vvard , that he may
fire his other broad ſide upon us , (Starboard hard) get too
Larbord Fore-take, trimme your Top-ſayles , runne out our
Larboard Gunnes, he fires his Starboard broad ſide , upon us ,
and poures in his ſmall ſhot (Starboard) give not fire untill
they fall off , that the prize may receive our vvhole broad-ſide
(Steddy a port) give fire Gunner , his maine-top maſt is by
the board , and our laſt broad ſide hath done great execution
(cheerly my Mates , the day vvill be ours) he is ſhot a head ,
and beares up before the vvind to ſtop his Leakes , (keep her
thus) vvell ſteer'd , vve are to the Sou-hvvard of the prize
(port hard) beare up before the vvind that vve may give him
our Starboard broad ſide , Gunner is there good ſtore of
Caſe ſhot in our Gunnes (yea, yea,) port) edge tovvards him ,
Gunner vvhen you give fire , bring your Gunner to beare
amongſt his men upon the Deckes that they may ſhare our
caſe-ſhot, (vvell ſteer'd) vvee are cloſe aboard, give fire (Star-
board) vvell done Mr. Gunner , they lye heads and points a
board the chaſe , vve are ſhot a head , he ſtrikes his Fore-top-
ſaile , he vvould fall a Sterne, he hath his belly full , but vvee

muſt not leave him thus, aluffs into the wind, he braces his Fore-ſaile and Fore-top-ſaile a Backe ſtayes, (port hard) get too Starboard Maine-tacke and Starboard Fore-tacke, (a-luffe) hawle forward maine-Bowline, and maine-top-ſayle Bowline, (aluffe, aluffe,) well ſteer'd (no neere) come ready, ready, that we may go about, wee ſhall fetch her again upon this board, a Lee the Helme, the fore-ſaile is a Backe-ſtayes, let riſe main-tacke, let goe maine-bowline and maine-top-ſaile Bowline, hawle about Maine-ſayle, get too Maine-tacke, and Fore-tacke, hawle aft your Maint-ſheate and Fore-ſheat, trimme your Top-ſailes (no neere) hard no neere, the ſhip will ſtay, flat in your Fore-ſayle ſhe falleth off againe (thus) (warre) (no more) (aluffe) the prize puts abroad a white flag of truce, (aluffe) we will weather him, and then keepe him under our Lee, he hailes us with his voyces, mind what he ſayes, (Quarter for our lives, and vve yeeld the Ship and Goods) good quarter is granted (provided) that you forth-with take in all your Sayles and furle them, untill wee come aboard vvith our ſhallop, if you unlooſe a knot of Sayle expect our broad-ſide and no Quarter, thus leaving the Man of Warre, to enter his prize, I vvill likevviſe leave you thus much of the practicke part of Navigation, to all your Judicious cenſures, by vvhich you may perceive, that I have turned and vvorked the Ship in all aſſayes, vvith vvords and proper Sea-phraſes: And if I vvere at Sea, I ſhould performe it both by vvord and deed. Therefore let not Ignorance, the arch enemy of Arts, deceive himſelfe, and thinke that three times turning vvill turne my braine, but that I vvill turne to vvindvvard vvith him for all his ſhooes in his ſhop, and vvhen I have done, vvill as eaſily turne him in the Theorick, vvhich vvay I liſt, As I can the Ship vvith the practicke.

Of the Compasse.

THe foure principall Hand-maids that alvvayes vvaite upon the expert Marriner, and crovvne his Conclusions vvith everlasting credit, and are these loving Sisters *Arithmetick*, *Geometry*, and *Astronomy*. By the operation of these excellent Arts Navigation is daily practised by some sevv expert sea-men, but much more abused by many hundreds of Ignorant men, that knovv little or nothing vvhat belongeth to any of them; yet vvill undertake to direct a ship to any place upon the Terrestiall Globe, vvholly trusting that favourable Fortune vvill make them famous, but oftentimes a disastrous period concludes their undertakings, vvith the lamentable losse of divers mens Goods and Lives; But to returne to the matter intended I vvould have it understood, that although I have named these four Arts, as the originals of Navigation; yet that I doe not meane in this place to insist upon each severall science in particular; for then I should increase my discourse to a great volume, before I come to the purpose that I point at; Therefore it is supposed first, that hee that intendeth the Art of Navigation hath all manner of Arithmeticke in a readinesse, vvhich if he vvant, there are divers Bookes already extant that vvill Instruct him, as namely, *Record, Baker, Blundivell, &c.* And for Geometry, *Speedels* Extractions, and *Digges* his Geometry, vvith many others. And for Navigation, and Astronomicall knovvledge, so much as is necessary for a Sea-man, vvill be discovered in the Projection, and use of divers Instruments of Navigation, vvhich vvill hereafter follovv in the insuing vvorke.

And novv to proceed in a Regular forme, for the attaining the full knovvledge of this famous Art, the *Sea Compasse* presents himselfe as the first principall, framed by the operation of the *Magneta*, vvhich although it be a thing in respect of the quality beyond our Capacities; yet his uses is
the

the firſt part that is neceſſarie to be underſtood, and muſt even bee the foundation to all future concluſions, (as letters are to expreſſe Language) and not un-fitly be compared as a beginning of the ſame nature, for firſt, you teach your children no know the letters by name, and ſo in the like manner vve teach our youths, and boyes (vvhich vvee intend to make Navigators) the points of the Compaſſe by name, reaſon as yet (being oenly empty ſound on both parts) then as you proceed to ſhevv your Children the nature of joyning Letters, and making ſyllables of divers ſorts and ſounds, ſo vve after the points are grovvne frequent and common, teach them to joyne or ſpell, by ſhevving them hovv the Winds blovveth, and demanding vvhat point it commeth from, as likevviſe by ſetting the Capes of Land and the bodies ſcituated in the Heavens, (as Sunne, and Starres,) and then requiring vvhat point runneth vvith them: and novv as Children vvhich knovv their letters and ſyllables, attaine in ſhort time to the reaſon of Reading, ſo your youths having once the thirty two points of the Compaſſe as perfect in generall, as Eaſt, Weſt, North, and South, are to all men in particular; will in ſhort ſpace conceive by what reaſon wee guide the Ship, and ſhape our Courſe betwixt place and place. The Compaſſe which wee uſe to direct our Courſes by, is onely in the Circle of ſome 8 or 9 Inches diameter, and is divided into thirty two parts or Points, interſecting each other onely in the Center, and theſe Points have their ſeverall denominations, as the Figure doth expreſſe the whole Circle which is divided into two and thirty equall parts or Points, (as afore-mentioned) is likewiſe devided into 360 equall parts or Degrees; the Compaſſe alſo containeth ſixteen diſtinct Rombs or Courſes, for each ſeverall Courſe hath two of the points of the Compaſſe by which hee is expreſſed; as for Example, Where there is any place that is Scituated South-weſt, in reſpect of another place, wee ſay, the Rombe or Courſe that runneth betwixt them is South-weſt and North-eaſt, if the place

beare

bear North, we say the course is North and South, if East we say, East and West, &c. Now the Wyers being discreetly touched, and this plaine Superficies, or Fly-playing, at the least motion upon his perpendicular pinne beareth him upon his point in the very Center. The instrument is compleat in his parts, and in the whole doth represent the Horizontal Circle, which you may see in any plaine Superficies, as at Sea, where looking round about, the (intersection which the Heavens maketh with the Waters) sheweth that you are in a Center, and that all places of the Horizon are of equal distance from you. Now this little Instrument of the Compasse, sheweth the same thing in small, which you behold in great, and by reason of the excellent quality of the *Magnet*, which turneth the *Flower-de-Luce* ever towards the North, all the thirty two Points of the Compasse directeth with the same truth according to their several denominations, so that nothing can appear within your Horizon, whether it be Ilands, Rocks, Ships, or such like, but you may straight look upon your Compasse, and one of the 32 points will runne right with the object discovered, which according to the denomination of the point, we conclude it beareth, or is scituated from us; therefore it is most necessary, that all Navigators should have the points of the Compasse so exactly ingrafted in their mindes; that at the first sight in all essayes, there happen not any mistake, which may prove many times very dangerous, to the hazard of Ship & goods, with lives and all; therefore for the benefit of those young Practitioners, which perchance are as yet unacquainted with them, I have here framed this Figure following, representing the Sea-Compass with his 32 Points, and 16 Rombs or Courses, unto each of which I have annexed their several denominations, signifie by the Letters at the end of each several Point; and thus much for the present concerning the Sea-Compasse as the first principal or part of Navigation, and not in this place to proceed to the manifold Conclusions which are performed

E   through

through his aide and application, as will be manifested here-after.
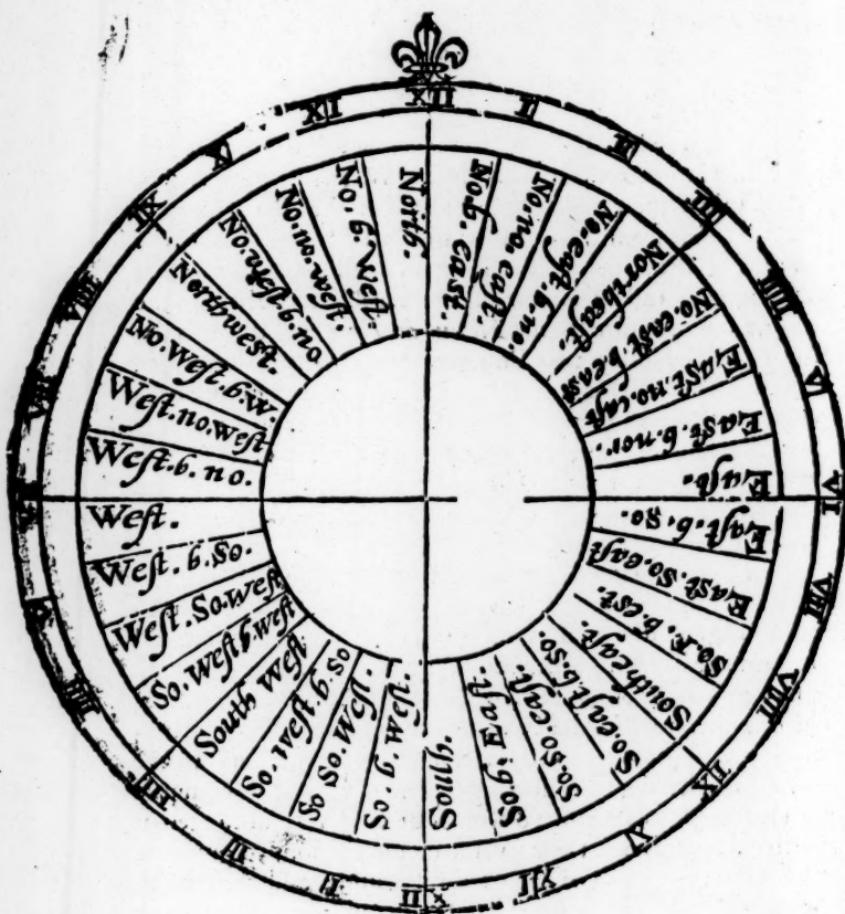
### The Ebbing and Flowing of the Sea, and the Moons Motion.

He next neceſſary to be learned in order by the Practitioner of Navigation, is to know the certaine time of the Ebbing and Flowing of the Sea in all Ports, or Creekes, commonly called by the Sea-man, *The ſhifting of Tides*; which by Experience is found to be governed by the Motions of the Moon; therefore, I would ſhew you now in the firſt place, her ſeveral Courſes, and when ſhe hath ſwift Motion, becauſe it will appear more properly, where I ſhew you Arithmetically how to find the Moons age, and what other Concluſions are to be wrought by Arithmetick, which may be, ſome of you that read this Book are not very expert in; wherefore, I will firſt ſhew the uſe of a ſmall Inſtrument which I have here framed, whereby the meaneſt Capacity ſhall be able, not onely to know the Age of the Moon, with what Flood or Ebbe it maketh in all the Channel, and in every Port or Creek, but ſhall likewiſe be able to know what a Clock it is at any time of Night; and divers other Queſtions in Navigation, onely by moving the Indexes of the Inſtrument, according as the queſtion ſhall require, which I will ſhew at large how it may be performed, & then I will likewiſe ſhew how it is to be done by Arithmetick, but firſt for your Inſtrument it muſt be projected according to the following Figure. For the framing of this Inſtrument, you muſt have three ſmall pieces of boards well plained and exactly divided, according to the ſame manner as I have formed it in the Figure, the biggeſt of which boards having the 32 Points of the Compaſſe, and the innermoſt Circle containing 24 Houres, muſt be ſome-

thing

rhing thicker then the other, the next Circle being divided
into 30 equal parts, reprefenting the diftance of 30 times 24
hours or 30 natural Dayes, is attributed to the Sunne; the
other Circle, and the uppermoft of the three, having nothing
graduated upon it, is attributed to the Moon, and hath his In-
dex to be turned about as that of the Sunne, and may be turn-
ed or appyned either to the 39 Dayes, containing the Com-
putation of time betwixt Change and Change, or to the 24
Hours, as likewife to the Points of the Compafs, fo may the In-
dex of the Sunne be applyed, either to Time or the Points of
the Compafle; which being made plain by fome Queftions,
will appear both delightful and moft eafie to be attained unto,
and I hope the illiterate man will find it moft ufefull, & like-
wife, he that hath fome better knowledge, and can tell how
to conclude thefe eafie Queftions by other meanes, will fome-
times ufe this Inftument for variety fake. I will now firft
draw the Figure, and then will propound fome certaine quefti-
ons to make the Inftruments ufes appear, as the work folow-
ing manifefteth,

_Th_

Cut out both these Types, and place them upon the next Figure following, first *Sol*, and then *Luna*.
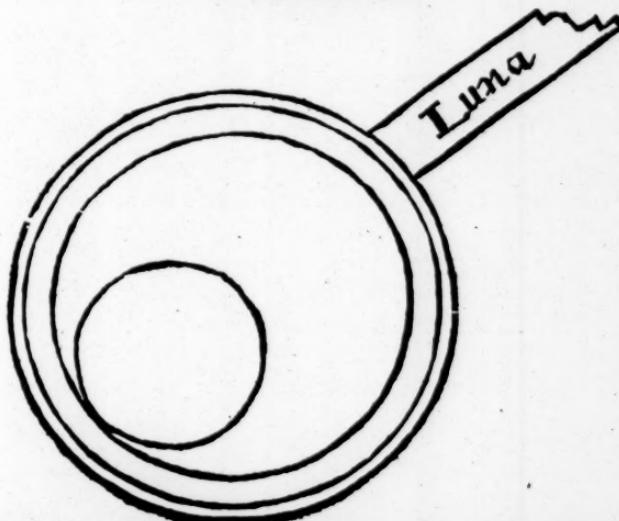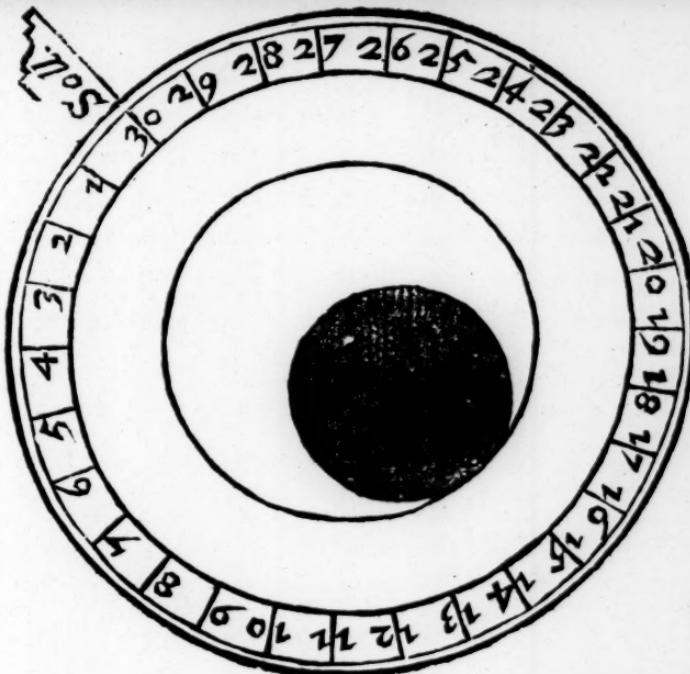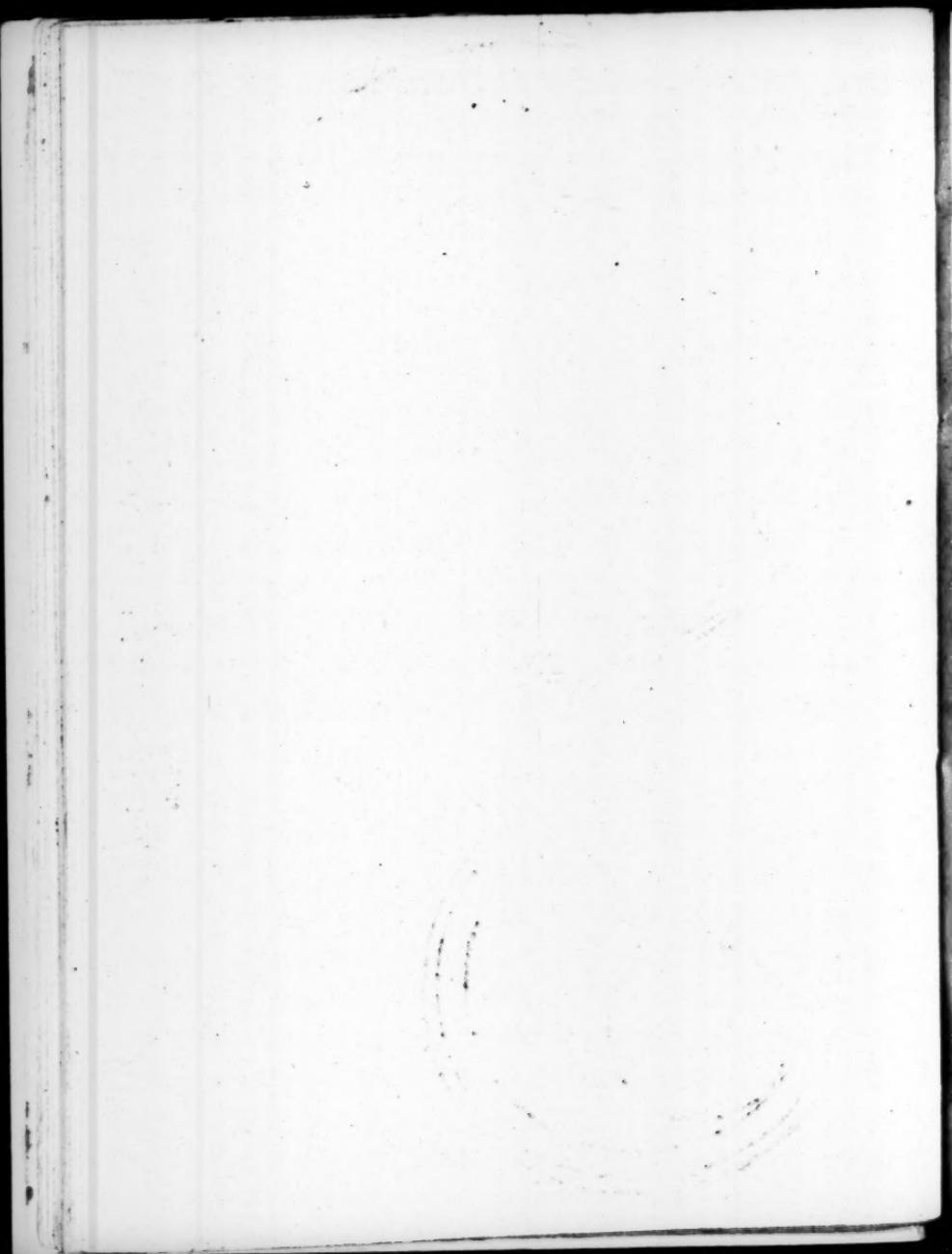
The Navigator.

The Instrument or Work.
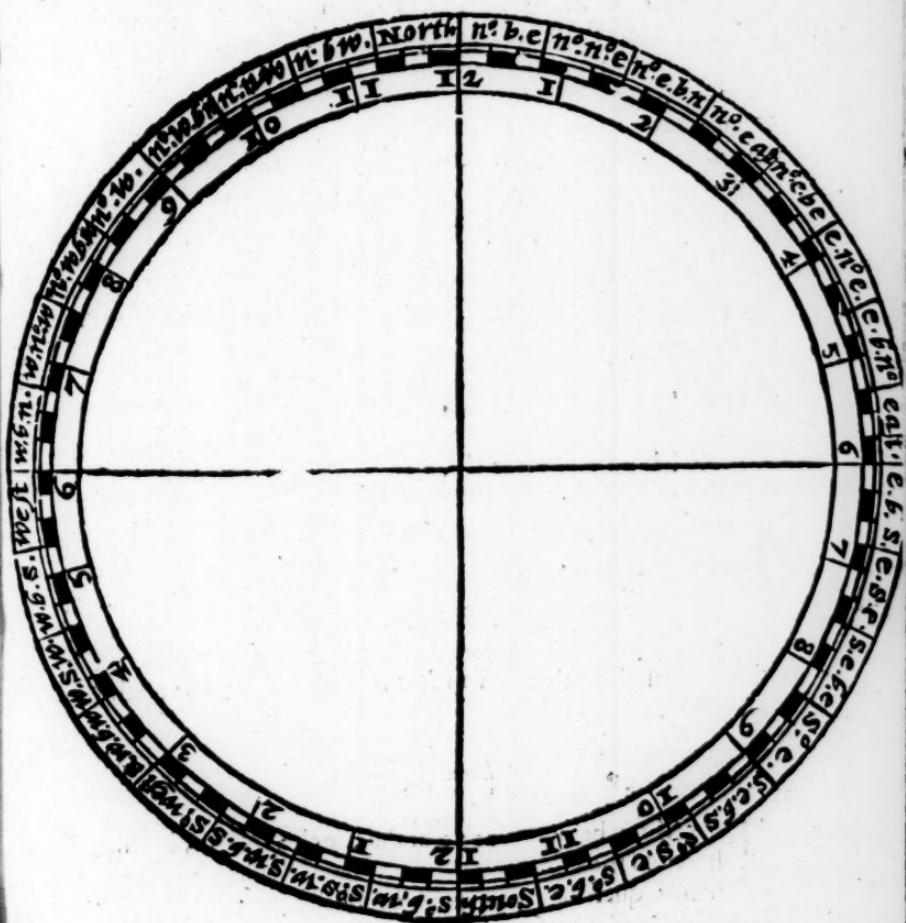
Firſt,

First Question.

THe Moon being 20 Dayes old upon what point of the Compasse shall she be at 10 of the clock at night.

You must note in this question, that the hour of the Day and the Moons age is given, and that to answer the question, you are to finde the point of the Compasse, which she will be upon at that instant; therefore place the Index of the Sunne upon the Compasse at the hour 10 of the Clock at night, then bring the Index of the Moon right over the 20 day of her age, which is graduated upon the Circle of the Sunne, and the Index of the Moon will point in the Compasse East, which is the true place of the Moon, and answereth the question required.

Second Question.

THe Moon 20 Dayes old, I demand what a clock it is when she is upon the point, E. S. E.

In this question, you have the Moons age and the point of the Compasse given, to find what a Clock it is; therefore turn the Index of the Moon until you have brought it to the point, E.S.E. and there hold it steady, until you bring the 20 day of her age right under the same Index, and then the Index of the Sunne, will shew that it is 11 ¼ at Night, which answereth the question.

Third Question.

THe Moon being — at 10 of the Clock at Night, I demand how old she is,

In this question, you must consider, that you have the point of the Compasse which the Moon is upon, and the hour that it maketh given, but you are to answer the question; by finding the Moons age; therefore bring the Index

of

of the Moon to the given point E , and then turne the Index of the Sunne , untill you bring it right with the hour given, which is 10 of the Clock at Night, and then obſerve what day the Index of the Moon cutteth , and you ſhall find the 20, which is her age , and anſwereth the queſtion demanded with truth.

Fourth Queſtion.

THe Sunne being Weſt , and the Moon Eaſt , I demand what a Clock it is, and how old ſhe is.

In this queſtion , you have onely the Points of the Compaſſe given that the Sunne and Moon are upon , therefore turne the Index of the Sunne due W. holding it ſteady upon that Point , then bring the Index of the Moon to poir due E, and you ſhall have under the Index of the Sunne in the Circle, containing 24 hours , 6 of the Clock at night , and under the Index of the Moon, in the graduated Circle of her 30 dayes contained betwixt Change and Change , and you ſhall find 15, which is her age, and anſwereth the queſtion.

Fifth Queſtion.

THe Moon being 15 dayes old , I demand what a clock it will be when ſhe is upon the point, N. E.

In this queſtion, you have the point of the Compaſſe given, as likewiſe , the Moons age, and to anſwer the queſtion, you are to give the hour , wherefore bring the Index of the Moon unto her point N. E. then holding it ſtill , turne the Index of the Sunne , until you have brought the 15th. day of her age, right under the Index of the Moon , and then the Index of the Sunne , will point right in the Circle of 24 hours to 3 of the Clocke in the afternoon , which anſwereth the queſtion.

Note alwayes, that if your queſtion be reſolved , and that the Index which anſwereth the queſtion , point to the Eaſt-

ward of either N. or S. it sheweth the morning 12 hours, but if to the Westward of the N. or S. it sheweth the evening 12 hours.

Thus much I think will be sufficient to give any one of a reasonable understanding the full use of this Instrument, which by often practising these and such like questions, they will in short time be so ready in mind, that at the first propounding, you will be able to resolve them by memory, without any farther trouble, which will be a most excellent and profitable matter for the Practitioner of Navigation.
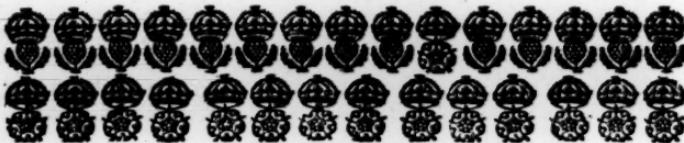
How to find the time of Ebbing and Flowing by this Instrument.

YOu are alwryes to consider what point of the Compasse the Moon is upon that day that it changeth, when it is full Sea in that River, Port, or Creek, which you are to find the Flood or Ebbe, which having found, you must consider, what hour belongeth to that point of the Compasse, which by turning the Index of the Moon as before is shewed; you shall have the hour alwayes right under her Index, upon the day of her Change throughout all the points of the Compasse, and now you must proceed to find full Sea in this manner; first turne the Index of the Moon, to the point of the Compasse that upon her Change day maketh full Sea, in that Port, River, or Creek, which you desire to know, and there holding it still, consider how old the Moon is, then turn the Index of the Sunne, until you have brought the day of the Moons age right under her Index, and then the Index of the Sunne will answer the question, and point right with the hour, as by these Examples will appear.

First,

First Question.

THe Moon 20 dayes old, at what a Clocke will it be full Sea at *London*-bridge.

Here you are to confider the point of the Compaffe that the Moon is upon, when it is at full Sea upon her Change day, which in this Port is found by obfervation to be alwayes S.W. or N. E. (the oppofite point;) therefore obferve, whether you would know the hour of the Day, or the hour of the Night, that is full Sea, if it be the hour of the Day, then bring the Index of the Moon, to the S. W. point, if of the Night, to the N. E. and there holding it ftill, turne the Index of the Sunne, until you bring the 20 day of the Moones age right under her Index, and then the Index of the Sunne, will fhew in the Circle of 24 houres, 7 of the clock in the Morning, or 7 of the clock at Night, if you fet the Index of the Moon to the point N. E. then the Index of the Sunne will fhew 7 of the clock in the afternoon, at which hour it is their full Sea when the Moon is 20 dayes old, which anfwereth the queftion demanded.

Note alwayes, that the Moon betwixt change and full, is ever to the Eaftward of the Sunne, ftill feparating her felfe from the Sunne, until fhe be at the full, but after the full, in regard fhe hath now performed more degrees in her feparation then is contained in a Semi-circle, fhe is gotten to the Weftward off the Sunne, and now applyeth towards the Sunne againe, until her change Day, which if you obferve the Inftrument, it doth plainely demonftrate.

Second Question.

THe Moon being 16 dayes old, I demand at what hour it will be full Sea at *Waymouth*.

In this queftion, firft, confider what Moon maketh full Sea in that Port, which by experience is found to be Eaft and

West; now therefore becaule the Moon is to the Welt-ward of the Sunne; and is before the Sunne, being now 16 dayes old, you muft bring the Index of the Moon to the point W. and there holding it, until you have turned the Index of the Sunne, and brought the 16 day of the Moons age right under her Index, and then the Index of the Sunne will fhew that it will be three quarters paft 6 in the Morning, when it is full Sea at that Port, the Moon being 16 dayes old.

Third Queftion.

THe Moon being 16 dayes old, I demand at what a clock it will be full Sea at *Dover* in the Peere.

In this queftion, you muft confider what Moon maketh full Sea upon the change Day, which is found to be N. and S. therefore I bring the Index of the Moon to the point N. and there hold it until I have brought the 16 day of the Moons age right under her Index, and then the Index of the Sunne will fhew three quarters paft 12 a clock, which anfwereth the Queftion.

Fourth Queftion.

THe Moon 10 dayes old at what a clock is it full Sea at the Ifland of *Garnefey*.

Here, at this Iland, at N. by E. Moon upon the change Day, maketh full Sea; therefore turne the Index of the Moon to the point N. by E. then turne the Index of the Sunne, until you have brought the 10 day under the Moons Index, and then the Index of the Sunne, will fhew that at three quarters paft eight of the Clock in the morning it will be full Sea, which anfwereth the Queftion.

Fifth Question.

THe Moon 26 dayes old, at what a clock will it be full Sea under *Bulloine* in *France*.

In this place, a N. E. by N. Moon upon the change day maketh full Sea; therefore bring the Moon to the point N. E. by N. and then turne the Sunnes Index, until 26 be right under the Moons Index, and then the Index of the Sunne will shew, that at three minutes past 11 of the clock, it will be full Sea.

Sixth Question.

THe Moon 29 dayes old at *Amsterdam*, what hour maketh full Sea.

In this place a S. W. and N. E. Moon upon the change day maketh full Sea; therefore bring the Moons Index to the point S. W. or N. E. and then bring the 29 day under her Index, and the Sunnes Index will shew, that it is full Sea at a quarter past 2 of the clock, which answereth the Question.

Thus I conclude, for finding the flowing and Ebbing in all parts, by the aid of this Instrument, and now I will in brief shew how to find the Moones age by Arithmeticke, and how to account your Tides, as likewise, to find the Prime Number, and the Epact, which are the principal matters to find the Moons age, (and in short) the Motion of the Moon.

How to find the Prime Number, and what it proceedeth from.

THe Prime Number is the space of 19 yerres, in which time the Moon performeth all her Motions with the Sunne, at the expiration of which terme she beginneth againe in the same signe of the Zodiacke, that she was 19 yeares before, and alwayes finisheth her whole course with
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the Sunne, in that terme, which she never exceedeth, so that if I have a desire to know any thing concerning the Moons age, or her motions in the Heavens, that she hath made many yeares past, or (to come) onely by the help of Addition and Subtraction you may be resolved with as much certainty, as if it were any thing in present: but to proceed for the finding of this Number so useful, you must alwayes take this course. In that year of our Lord, which you would know what is the Prime Number, (adde one to) and then divide it by 19, and that which remaineth upon the division, and commeth not into the quotient, is the Number required; as for Example, in the year of our Lord, 1631, I demand, what is the Prime Number, now therefore if you adde one, to the aforesaid year, and divide the of-come by 19, there will remaine upon the division, that commeth not into the quotient 17, which I say is the Prime Number, and for this matter being so easie, I need not use more demonstrations, onely you are to observe, when you find nothing remaining upon the division, that is the last year of the Moons Revolution; and therefore may conclude, that 19 is the Prime for that yeare, and you must also note, that the Prime alwayes beginneth in *January.*

How to find the Epact, and what it proceedeth from.

THe Epact is a Number that proceedeth from the difference which is made in the space of one whole year, in accompting the *M*oons term, and the Sunnes, for the *Solar* year doth containe neerest 365 dayes, 8 hours, 48 min. and the *Lunar* year doth containe after the rate of allowing her 30 dayes betwixt Change and Change, 360 dayes but 11 hours, and 16 minutes, which in the terme of each 30 dayes must be frustrated, because 30 dayes, is so much more then in truth is contained, which in the terme of 12 *M*oneths, amounteth to 5 dayes, 15 hours, and 12 min. and the *Lunar* year wanteth of the *Solar*, 5 dayes, 8 hou. 48 min.

neerest

neerest, both which summes being added together, will make
11 dayes; and now to proceed; to find the Epact, do in this
wise multiply the Prime Number for the year, by the diffe-
rences of the Solar and Lunar yeares, which I have shewed
to be 11 dayes, and then divide the product by 30 dayes,
and that which remaineth upon the division, and commeth not
into the quotient is the Epact; as for Example, in the former
yeare, 1631, where I shewed you to find the Prime Number,
which appeared to be 17. Now therefore if you multiply 17,
by 11, it will make 187, which being divided by 30, there
will remaine upon the division, that commeth not into the
quotient 7, which is the Epact for that yeare, and this is suf-
ficient to be expressed in so facil a matter; onely you are e-
ver to note, that the Epact beginneth in *March*, by these
examples. I make no question but you understand the reason
of the Prime, and Epact, as likewise how to find them in any
year that you desire, but in regard those which are unacquainted
with Arithmetick, are debarred from the way of these two
most necessary Numbers, I will make a small Table for 40
years yet to come, wherein any one shall most facilly find the
Prime and Epact, for any yeare that he shall desire, but in the
first place, I will shew the use and operation of these two
Numbers, in finding the Moons age and the shifting of
Tides.

How to find the Moons Age, at any time.

HAving attained to the finding of the Prime and Epact
you may find the Moones age at any time desired, in
the manner, first, consider the Moneth and day of the Moneth
that you desire to find her age, and then reckon how many
Moneths are contained betwixt your present moneth, and
the moneth of *March*, including both those Moneths, in your
Number, then adde the Epact for that year, and all those
summes being added together, is the Moons age if it exceed,

not 30, which if it doth you must cast away 10 so often as you can, and then the remaining is her age; as for Example, in this present year of our 1634, the Prime Number is 1, and the Epact is 11, now I demand, what age the Moon is of, the 24th. day of July, from March to July, is 5 moneths, (including both Moneths) which being added to 24, the day of the Moneth maketh 29, and then adjoyne the Epact, it will make 40, therefore casting away 30, there will remaine 10, which is the age of the Moon, and answereth the question.

How to find when it is full Sea in any Port, Creek, or River.

HAving shewed you formerly how to find the Prime, Epact, and age of the Moon, at any time desired, you may proceed for the finding of full Sea in any place, in this manner; first, you must consider, as a-fore is shewed, what point of the Compasse the Moon is upon, on her change day, when it is full Sea in that Port, which you desire to know, and likewise what hour is proper for that point, which having considerd, as likewise, how old the Moon is, you may by Arithmetick instantly resolve, the Moons age being multiplied, by 4, and the off-come divided by 5, adde the hour proper to the Point of the Compasse the Moon is upon, in her time of Change, if there remaine any thing upon the division that commeth not into the quotient, for every one that remaineth you must add 12 minutes, for 2, 24 minutes, for 3, 36 minutes, for 4, 48 minutes, and more then four you shall never have upon your division; by a few Examples, the manner of worke will appeare most easie and plaine, which of purpose, I will now take those 6 questions, which formerly I did resolve by the Instrument, that the worke may appear more plaine and certaine, to those which are acquainted, and can work by them both, and the truth of the Instrument will be more plaine, by comparing both together, as for example.

First,

First Question.

THe Moon 20 dayes old , at what a Clocke it is full Sea at *London* bridge.

Here you must confider the point of the Compaſſe that maketh full Sea upon the Change day, which is found to be S. W. and N. E. and the houre proper , to that point is 3, therefore I proceed and multiply 20 the Moones age , by 4, and it maketh 80 which I divide by 5, and there commeth 16 into the quotient , which is houres , and nothing remaineth upon the diviſion ; therefore, I onely adde 3 to 16 and it maketh 19 which becauſe it exceedeth 12 I caſt away 12 as often as I can, and there remaineth 7 which is the time of full Sea and anſwereth the houre demanded , you muſt ever note, that if the generall ſumme exceed 12 you muſt take 12 ſo often as you can out of it, and the remainder will anſwer the Queſtion moſt certainly.

Second Question.

THe Moon is 16 dayes old, at what a clocke will it be full Sea at *Waymouth.*

Here at this Port upon change day, an E,& W.Moon maketh full Sea , therefore you muſt multiply 16 the Moones age by 4 and it will make 64 which being divided by 50 there commeth into the quotient 12 houres , and there remaineth upon the diviſion 4 which as hath been formerly ſhewed , ſignifieth 48 minutes; therefore adjoyning thoſe 48 minutes unto 12 houres, it appeareth moſt plaine that at the afore-ſaid Port , it will be full Sea at 48 minutes paſt 12 of the clocke , which anſwereth the queſtion.

Third Question.

THe Moon being 10 dayes old, at what clocke is it full Sea a the Iſland of *Garneſey.*

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Here

Here at this Port upon change day, a N. by E. Moon ma-
keth a full Sea, therefore I multiply 10 dayes being the
Moones age by 4 and it maketh 40 which summe I divide
by 5 and there commeth into the Quotient 8 houres , and
nothing remaineth upon the division, therefore you must
onely adjoyne the houre proper to the point , and the question
is answered, which upon this point of N. by E, is 12 houres,
48 minutes; therefore I omit the 12 houres, and onely adde the
48 minutes, so that it appeareth at 8 of the clock , and 48 min.
past, it will be full Sea, in the afore-said Port.

Fourth Question.

THe Moon 16 dayes old at what a clocke is it full Sea at
Dover in the Peere.

In this place , a N. and S. Moone, therefore work as afore
hath been shewed, and you will find it, at 40 minutes past 12 a
clocke.

Fifth Question.

THe Moon 26 dayes old , at what a clock is it full Sea at
Bulloyne in France.

Answer, a N. E, by N. moon, therefore at 11 a clock and
2 min. past.

Sixth Question.

THe moon 29 dayes old , at what a clocke is it full Sea at
Amsterdam. Here a S. W. and N. E. moon , therefore at
2 houres and 12 min.

Here after followeth the Table for the Prime and Epact,
Calculated for 40 yeares yet to come from this present year
1634 the Table is so plain, it cannot chuse but be understood by
any at the first sight.

Of the Moones Motion, and the proportion of Time betwixt Tide and Tide.

HAving formerly shewed the severall wayes how to find the Moones age, fist, by the helpe of Instrument, and then Arithmetically, by getting the Prime Number, and Epact, for the yeare of our Lord: having which, you are able to find the time of full Sea in any Port you desire; I will now shew you in briefe, the motions of the Moon: and the reason of the difference of time betwixt Tyde & Tyde, the motions of the Moon are two-fold, first, a violent motion, which is from E. to W. caused through the Diurnal swiftnesse of (*Primum mobile*) secondly, a naturall motion, from W. to E. in which motion the moon doth require 27 dayes and 8 houres, to come to the same minute of the Zodiacke, from whence she departed, but comming to the same Pricke where she was in Conjunction with the Sunne last, she doth not find him there againe, in regard the Sunnes naturall motion is every day one degree or 60 minutes E which maketh so much difference, that the moon must performe two dayes, 4 houres, and 36 minutes neerest more then her naturall motion, before she can fetch up the Sunne to come into conjunction with her, so that betwixt Change and Change, is 29 dayes 12 houres and 36 minutes, by my account, but the Sea-man, doth allow just 30 dayes, betwixt change and change, in regard he will not be troubled with small fractions of time, in his account of Tydes, which bringeth no great errour, therefore experience being my best authority in this point, I will likewise give the same proportion, allowing the moone in every 24 houres to depart from the Sunne 12 degrees, or 48 minutes of time, which is untill her full East but then having performed in her naturall motion, above the quantity of a Semi-circle, she is then to the West, as reason expresseth. Now if the moone move in 24 houres 48 minutes then in 12 houres, she must move 24 minutes, and in 6

houres

houres 12 minutes, by this proportion, each houre she moveth
2 minutes, and as the difference of time is, so is the difference of
Tydes.

A Table shewing the Prime and Epact for 40 yeares yet to come.

Yeare of our Lord.	Prime.	Epact.	Yeare of our Lord.	Prime.	Epact.	Yeare of the Lord.	Prime.	Epact.	Yeare of our Lord.	Prime.	Epact.
1644	11	1	1654	2	22	1664	12	12	1674	3	3
1645	12	2	1655	3	3	1665	13	13	1675	4	14
1646	13	23	1656	4	14	1666	14	4	1676	5	25
1647	14	4	1657	5	25	1667	15	15	1677	6	5
1648	15	15	1658	6	6	1668	16	26	1678	7	17
1649	16	26	1659	7	17	1669	17	7	1679	8	28
1650	17	7	1660	8	28	1670	18	18	1680	9	9
1651	18	18	1661	9	9	1671	19	29	1681	10	20
1652	19	29	1662	10	20	1672	1	11	1682	11	1
1653	1	11	1663	11	1	1673	2	22	1683	12	12

Of the Globe.

AFter that the young practitioner of Navigation hath at-
tained to perfect knowledge of all the points of his Com-
passe, and that he is well acquainted with the shifting of
all manner of Tydes, the next principall, resteth most proper-
ly upon the Terrestial Globe, where all manner of distances
are to be measured, which cannot be attained unto, without
knowledge of the nature and quality of many severall Circles
which girt the whole body, therefore I will briefely deline them,
and shew reasons in the matters of most Importance.

Of

Of the Ball of the Globe.

FIrst, the Ball or round body in his upper superficies, doth onely demonstrate unto us the Hidrographicall description of the Sea, and the Geographical description of the Land, this Superficial knowledge, the weakest Capacity discerneth at the first sight, for by the description of the Seas and Lands, it appeareth which is Sea, and which is Land, and then joyntly together make one round body is most evident.

But this knowledge proceeding not from reason, and the Rules of Art, is as farre from perfection as the (*Chaos*) vvas before it pleased the Divine Creatour, to separate the confused mixture of the Elements into their proper places; for novv you behold a body of an exact rouud forme, but are not able to measure any part of him, neither knovv hovv it is Situated, in respect of the Spheares which turne round about him, novv then it is most necessarie for us to set this Round body in his proper place, and then to divide him with Circles according to Art, whereby we may gaine the knovvledge of each several places, distance from each other, as likewise how they are situated, in respect of the motions of the Sunne and Starres.

First, then I place the whole Globe, according to my conceived apprehension to be even Situated in the very Center, and that this whole Body in respect of the Heaven hath in all respects, the same resemblance that a small point or pricke being the Center of a large Circle (hath to his circumference,) the Globe being thus placed, it is most facill to conceive that a perpendicular line falling from the Heavens: and running through the Globe or Center, to the opppsite part of the Heavens, can be but in two certaine points, which two points we terme or call the Poles of the VVorld, expressed by the denominations, of Articke and Antarticke, and the perpendicular, we call by the name of the Axeltree, because upon

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the period of their extreames, we suppose the Spheares are turned about by the force of (*Primum mobile*) or the first mover, the Terrestial Globe being thus Situated in your imagination, with this Axeltree running directly through him, may now be girt with his several Circles, whereby evident and infallible conclusions, we are able by plain demonstrations to give all manner of distances, as likewise the content of the whole body.

Of the Equinoctial.

THe first Circle, as the foundation for all the rest which I will describe upon the Terrestial Globe is the Equinoctial, whicv must be extended from East to VVest leaving both the afore-mentioned Poles of one equal distance, from all parts of the whole Circle, this Equinoctial Circle is divided into 360 deg. and importeth by his denomination his nature and quality, by two distinct operations; First, in dividing the whole VVorld into two equal parts, allowing the one halfe of the Terrestial Globe, to appertaine unto the North or Articke Pole, and the other to the South or Antarticke Pole, Secondly, alwayes when the Sun by his yearly motion intersecteth the Equinoctial points, the dayes and nights are of one equal length in all parts of the VVorld, and so the denomination of the word, is probable to come from the Latin (*Equales dies & noctes,*) and now the Globe being onely circled with the Equinoctial, the foundation of measuring is laid, but small use can be dravvne from this foundation, untill we raise some other buildings vvhich vvill shevv his use by the effects.

Of the Meridian.

THe Terrestial Globe having as yet but one onely Circle, namely, the Equinoctial, vvhich divideth the VVorld into tvvo equal parts, I find it most convenient to describe another Circle of the same magnitude, though of a several nature
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ture, namely, the Meridian this Circle runneth directly North
and South, even through the imagined points which wee
terme the Poles; and intersected the Equinoctiall, at right
Angles: so the Globe is Quartered into foure equal parts,
which the meanest capacity cannot chuse but conceive, now
by the ayde of these two Circles, we are able to measure all
parts or portions of all other Circles, that are extended be-
twixt any two places upon the Terrestiall Globe; as likewise
to give the whole content of the circumference, in any kind
of measure that shall be required: The certain truth of our
measuring is grounded upon taking the Altitude or height of
some known body situated in the Heavens, for by such an obser-
vation, we conclude an infallible certainty as by a short demon-
stration shall appeare.

As for Example, Suppose I am neere in *London*, a place well
knowne by divers heedfull Observations, to be Situated in
the Latitude or breadth from the Equinoctall 51 Degrees 32
minutes Imagine, that I take any certain number of any sort
of measure, directing my Course dew South, untill I find by
the Starres or Sunne, that I have altered my Latitude or bredth
one Degree, which by experimental Conclusions is found,
must needs be sixty English Miles or twerte English
Leagues, before I can have any such alteration: Now then
I conclude, if I must goe 60 English miles or twentie Leagues,
due South, before the North-Starre will be one Degree lower
then it was; That if I were under the Pole, where I should
have the North-Starre in my Zenith, I must needs goe or
Sayle 90 Degrees, before I come to bring the Equinoctial in
my Zenith, and the Starre in my Horizon, for betwixt the
Pole and Equinoctial is a quadrat, or fourth part of a Circle
as before I have shevved. Novv then by the Rule of propor-
tion, (or reason) if one Degree of the Meridian require 20
Leagues, or 60 Miles, 90 of the same Degrees, vvill require
1800 Leagues, or 5400 miles, vvhich is one quarter of the
Globes circumference, and then it is most apparent, that the
whole Terrestial Globe is but foure times as much, vvhich

is

is 7200 Englifh Leagues, or 21690 Miles, and fo much is the whole circumference in the Equinoctial or Meridian, and now again, if one Degree containe 20 Leagues, or 60 miles, then 7200 Leagues, or 21600 miles, will containe in the fame proportion 360 Degrees, which is likewife the whole circumference of the Terreftial Globe in Degrees, and the fourth part of thofe Degrees muft needs be 90 Degrees, fo that by this demonftration, it appeareth there can be no doubt of the certainty of our meafuring. Novv then, thefe tvvo Circles of one magnitude, namely, the Equinoctial and Meridian, being exactly divided into 360 equal parts or Degrees, as you fhall ever find them upon the Terreftial Globe, maketh all kind of diftances betwixt any places affigned, moft facill to be meafured, for if you take the diftance of any tvvo places with your Quadrant, vvhich is onely a thin plate of Braffe, containing the exact fourth part of Degrees, either of the Equinoctial or Meridian, you vvill fee what quantity of Degrees are contained betvvixt them, which may foon be turned either into Leagues or miles, by allowing for each Degree 20 Leagues or 60 miles as hath beene manifefted before, thefe tvvo Circles thus divided and defcribed, and vvith certaine and infallible truth proved by the former demonftration, is fufficient to fatisfie any man for the meafuring of all forts of diftances, upon the Terreftial Globe, and the way of meafuring is fo plain, that it is not common fence, fhould find any difficulty; but yet you muft underftand, that although I have mentioned but one Meridian upon the Terreftial Globe yet you fhall finde divers Meridians defcribed upon all Globes, yet but one that is graduated or divided into Degrees, which ferveth as well as if they were all divided, for they are of one nature and quantity, and interfect each other in the very points which wee call the Poles, and all of them cut the Equinoctiall at right Angles.

The Meridian thus defcribed difcovereth moft evidently the fafeneffe of the Cards or Plats, which are projected in

Plano :

Plano : for there you shall finde divers Meridians likewise described (namely, all North and South lines) with one graduated Meridian as in the Globe , but you will finde them all parallels to each other in all Latitudes or breadths , even to the very Poles , where according to the Globe they should intersect each other ; so that when the foundation is false , you may well consider , what dangerous errours those runne into, which allow the Card or Plat, because most easie, most excellent for Navigation.

I have sufficiently defined these two Circles , by the aid of which, as hath been expressed , all manner of distances may be resolved. Yet there remaineth divers Circl.s which may be understood, or you will understand the nature and quality of the Globe but in part.

Of the Ecliptick.

THe Eclipticke is a Circle of the same Magnitude of this Meridian , and intersecteth the Equinoctiall at two certain points , which divideth it into two equall parts, but not at right Angles , as the Meridian , but with Acute or Sharp Angles , and so the greatest Arches of the Ecliptick, cannot be distant from the Equinoctiall above twenty three degrees , and thirty minutes, which 23 degrees, 20 min. is likewise the quantity of the Angle , which is ingendred by their intersections ; the chiefest use of this Circle , is to demonstrate unto us the yearly motion of the Sunne, through the twelve Signes of the Zodiack ; This Circle is divided into 360 degrees, shewing the daily motion of the Sunne , and these 360 degrees are distributed amongst the 12 Signes in a proportionable manner, namely, to each Signe thirty degrees, so that according to the Suns daily declination, we are able to shew the degree and minute of the Ecliptick , where shee intersecteth , which taketh his name according to the denomination of the Signe , by the knowledge of which, we conclude the degree and minute of the Sunnes declination or distance

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ſtance from the Equinoctial, which is the chiefe directer in finding how any place is ſcituated upon the Terreſtial Globe, in reſpect either of the Equinoctiall or Poles ; for though in a vulgar phraſe, it is commonly termed the Altitude or height of the place, where we obſerve the Sunne or Stars, with our Geometrical Quadrate, Aſtrolabe, Croſſe-ſtaffe, or ſuch like Mathematical Inſtruments. Yet I ſay, let the height of any body ſcituated in the Heavens (which each one of the meaneſt Capacity, is able at the firſt demonſtration to reſolve) is of no conſequence to diſcover the Latitude or breadth of that place, either from the Pole or Equinoctial, except you are able at time of obſervation, to give the true declination of the body which you obſerve, and then indeed you may conclude an infalible certainty, namely, how many degrees and minutes your place of being is both from the Equinoctial and Poles.

Of the Colures.

THe Colures are onely two Meridians, which are, as it were, bounds or marks, ſhewing what degree of the Ecliptick the Sunne interſecteth, when ſhe maketh her greateſt North and South declination ; as likewiſe, where and in what Signe ſhe interſecteth the Equinoctial, where ſhe hath no declination : Theſe interſections of the Colures, plainly demonſtrateth unto us, the diviſion of the four quarters of each Yeare ; and when they begin and ſucceed each other, as namely, the Colure which interſecteth the Equinoctial and Ecliptick, (where they like wiſe interſect each other) is called the Equinoctial Colure, and ſheweth that the Sunne hath no declination, from which interſection, we have the denomination of two of the ſame Yearly quarters ; for if the Sunne be in the laſt minute of *Piſces*, or entring into the firſt minute of *Aries*, it ſheweth the firſt our Spring, and that the Sunne hath paſſed that Equinoctial Point, and is making her North declination, whoſe glorious preſence as much reviveth both Man, Beaſts, and Plants, ſcituated towards the Antartick Pole, as her abſence maketh

them

them droop towards the Antartick, and this intersection is ever neer the tenth day of *March* : but if the Sunne be in the first minute of *Libra*, or the last of *Virgo*, when she intersecteth the Equinoctial, our Artick Pole mourneth for the Suns ensuing absence, and the Antartick rejoyceth for her approaching presence ; this Equinoctial point, sheweth the beginning of our Winter, and their Summer, which are scituated to the South, or Antartick, which ever happeneth near the 11th day of *September*.

The other Colure, is call'd the Solsticial Colure ; because the Sun having now his greatest declination, is not to be discerned for two or three dayes, to have any sensible alteration : This Colure intersecteth the Ecliptick in his greatest Arches, on either side of the Equinoctial, by which intersections the two other quarters of our Year are expressed ; as namely, if the Sunne be in the last minute of *Gemini*, or entring into the first minute of *Cancer*, it sheweth that the Sunne hath now her greatest North declination, and that now when she intersecteth her greatest Meridian at Noon, she hath the greatest Altitude above the Horizon, to all places scituated towards our Artick Pole, that is, possible for her to have, which is the cause that now we have our longest Dayes and shortest Nights, and now beginneth our Autumn or Harvest, and this intersection happeneth ever near the tenth day of *June*, but if the Sunne be in the last minute of *Sagittarius*, or entring into the first minute of *Capricorn*, it sheweth the Sunne hath now her greatest South declination, and is of the least Altitude above the Horizon, when she intersecteth the Meridian at Noon, to all that are scituated towards our Artick Pole, that she ever possible may be ; which causeth our shortest Day and longest Night, that is, the dead of our Winter, and the beginning of Autumn or Harvest, to all those which are scituated towards the South or Antartick Pole, this intersection ever happeneth near the 12th day of *December*.

Of

Of the Rombe.

THe Rombes or Courses, are all Circles of the greateſt Magnitude, onely when the Equinoctial is in your Zenith, but if otherwiſe, then I ſay they are Circles, bearing proportion with the Parallel where you are, as this plain and eaſie demonſtration will manifeſt.

Suppoſe that according to heedfull obſervation, our place of being were right under the Equinoctial Line, and that then we ſhould take any notice onely of the 32 points of our Compaſſe, according to each ſeveral Rombe of E. and W. and then doe but conſider that our place of being is in the very interſection of the Geographical Equinoctial; which is deſcribed upon all Terreſtial Globes, reaſon reſolveth the matter, for as that Circle of the greateſt Magnitude, is produced through the extream extenſion of E. and W. ſo the Rombe of Eaſt and Weſt ſhewed by the Compaſſe, muſt needs according to his greateſt extention, be of the ſame Magnitude, and then likewiſe, if you obſerve your N. and S. Rombe, you will with the like facility perceive, that it interſecteth the Equinoctial, or your E. and W. Rombe at right Angles, and therefore in that place, muſt be a Circle according to his greateſt extream of the ſame Magnitude with the Meridian : And then it followeth moſt plaine, that all the other Rombes running through the aforeſaid Interſection, muſt now be Circles of the greateſt Magnitude in their extreame extentions.

But if you obſerve the Rombes by your Compaſſe in any Parallel or Latitude, there will appeare but one Rombe or Courſe that will be a Circle of the greateſt Magnitude, namely, your N. and S. Courſe, which is alwayes your true Meridian (if the Compaſſe have no variation) and therefore according to his extream extention, is a Circle of the greateſt Magnitude ; But now your E. and W. Rombe will not hold proportion with the Meridian, becauſe all Parallels are leſſe then the

Equi-

Equinoctial, and therefore now all the rest of your Courses or Rombes besides your N. and S. course, are Circles according to their greatest extreams of a lesser Magnitude ; as for Example, suppose we are in the Latitude or Parallel of sixty degrees from the Equinoctial, and now observe the E. and W. and N. and S. Rombes by your Compasse, we shall finde they intersect each other at right Angles, but we must not conclude as before, that according to their extream extentions, they are both Circles of the greatest Magnitude; for here in this place, the Globe plainly demonstrateth unto us, that the East and West Rombe or Parallel in his greatest extream, is but halfe so bigge as the Equinoctiall ; therefore all the rest of the Rombes or Courses, except the N. and S. Rombe, must hold the same proportion. I would have the Practitioner of Navigation to discusse most diligently upon the aforesaid demonstrations, which are most easie, and will prove most excellent for producing the reall truth of many matters in Navigation, as by divers future conclusions will be manifested.

Of the Tropicks.

THese two Circles are of one Magnitude, and are Parallels to the Equinoctial, intersecting the Solsticial Colure, at the Latitude or breadth of 23 degrees 30 minutes, and these two Circles represent the utmost bounds of the Sunnes declination, on either side the Line, and are Touch-lines to the great Arches of the Ecliptick in two certain Signes, from whence they take their several denominations, namely, our Northern Tropick, toucheth the Ecliptick in the first minute of *Cancer*, and therefore is called the Tropick of *Cancer*, and the Southern Tropick toucheth the Ecliptick in the first minute of *Capricorn*, and is likewise called the Tropicke of *Capricorne*, betweene these two Tropicks, and under the Equinoctial, round about the whole circumference of the terrestiall Globe from East to West, is scituated that Zone which formerly hath been termed (*Torrida Zona*)

or

or the burning Zone , For in any place betwixt the two Tropicks , or within 23 degrees 30 minutes of the Equinoctial, you shall have the Sunne twice each yeare in our Zenith or Perpendicular , right over your head , at which time it hath been the opinion of many great Philosophers , that the powerful influence of the Sunnes bright beames being extended right down-wards , the heate occasioned by their re-verberation was in-sufferable , which indeed according to humane reason doth appeare very probable , and I am still of their opinions , though I have beene divers times for many Moneths together , sayling within the Torrid Zone , in most temperate weather , when the Sunne hath been according to our Course constantly right over our heads, or very near our Zenith point.

But this temperatenesse is occasioned by a Super-natural operation , which the Divine Creatour in his great Providence hath provided as a remedy to qualifie the parching heat of the Sunne-beames , namely, a certain breese or gale of winde , which ever bloweth betwixt the North and East in those parts. And it is worthy of observation to behold the great goodnesse of our Maker , that hath appointed this remedie daily to rise with the *Sunne* , whose powerfull beames would so much annoy the Inhabitants : and ever as the *Sunne* riseth above the Horizon by degrees , untill she come to her Meridian or greatest Altitude , so the breese of winde cometh by degrees , ever encreasing and blowing more freshly as the *Sunne* riseth : so that when the *Sunne* is at highest , the breese ever bloweth most freshly , and so decreaseth again , as the *Sunne* groweth lower , untill she be set under the Horizon , and then the breese is likewise done. And now yieldeth as much benefit to Mortall man by ceasing to blow in the Night , as it did profit him in qualifying the heat of the Day : For if it should blow as freshly in the Night time , as it doth in the heat of the Day , when the powerfull beames of the *Sunne* is qualified , it appeareth in common reason, that if the *Sunne* were wholly absent, and that the cool winde should still con-

continue, the Inhabitants would be very sensible of such a suddaine alteration, and feele it most extreame cold, and so would breed a great distemperature in their bodies; but the general calmes in the Night, when the Sunne is wholly absent, answereth a proportionable temper. And so we must only praise our Maker for his benefits, and not strive to render reason for super-natural matters, onely wee may presume in way of comparison, that as it hath pleased the great G O D to provide remedy beyond our reason, for the parching heat, that he hath likewise provided some super-natural means, for (*Frigida Zona*) or the Frozen Zone, that it may be Inhabited (as I make no question but it is) although in our reason the influence of the *Sunnes* beames, are of so small power in the Regions scituated near unto either of the Poles, that they can yield little comfort, either to Man, Beasts, or Plants; and again, the *Sunne* ever being absent and never seen above their Horizon, at either of the Poles, for sixe moneths together, when the Equinoctiall is betwixt them, and the distance where she maketh her motion, which exceedeth above a Quadrat or quarter of the Meridian, and therefore not to be discerned. Yet I say for all this, it may be Inhabitable, as no question but future times will discover both it and greater matters, that as yet remain wrapt in obscure clouds neer unto the Poles.

Of the Parallels.

UPon the Terrestiall Globe there may be described infinite Circles from East to VVest, betwixt the Equinoctiall and Poles which will be Parallels to each other, but no Circles described from North to South can be Parallels, because their Meridians Intersect each other in the points, tearmed the Poles; these parallel Circles described from East to VVest, have all of them one Center from whence they are described, namely, the Poles, and from that Center there can be but one Circle described of the same magnitude with the
Meridian,

Meridian which is the Equinoctial, all other Circular Paral-
lels are of lesse Magnitude, ever decreasing as they are descri-
bed neerer to either of the Poles : so that at the Laittude of
sixty Degrees, that circular Parallel is but halfe so bigge as the
Equinoctial, and ciecular Parallel scituated neerer ; the Poles
are still of lesse Magnitude untill you come to the very Center
or Pole, where it is not capable of any thing, being onely a
point.

The want of due consideration, what proportion each se-
veral Parallel, in each several Latitude beareth in respect ei-
ther of the Equinoctial or Meridian, is the cause the Naviga-
tors of these dayes produce such lame and imperfect Conclusi-
ons, as many times by experience I have found, that in run-
ning eight or nine hundred Leagues, and raising the Pole not
above 12 Degrees, the chiefe men in generall which were in
our Ship have been short in the true Longitude, when we were
in the height or Latitude of the place near upon two hundred
Leagues, which Errour I plainly Demonstrated, proceeded
onely for want of knowledge of the proportions of each several
Parallel ; but because those proportions were beyond their
Capacities to finde out, they would have all concluded, we
had made more way with the Ship then was accompted of, and
so would have cloaked a most grosse Errour with a general mi-
stake : But my reckoning being different from them all, and
pointing with the truth, I would not allow of their Conclusi-
ons ; but by plain Demonstration most easie for any of them
to conceive, I shewed the falseness of all Cards in *plano* :
(which have all equall Degrees in the Meridian) and what
lame Conclusions must be expected from those which in long
Voyages put their trust in them ; The Demonstration which I
produced was taken out of that worthy Author, Mr. *Edward
Wright*, who hath so excellently corrected and detected the
Errours of Navigation.

Suppose two Ships sayling right under the Equinoctiall
Line, and it were certainly known, that they were East and
West from each other the exact quantity of 100 Leagues, I
						demand

demand if those two Ships should now saile both of them due North untill the Pole were elevated 60 degrees, how many Leagues would these two Ships be from each other?

According to your Cards in *Plano*, which maketh all Meridians to be Parallels, and all Parallels of the same Magnitude with the Equinoctial, apply your Compasses, and you will finde even 100 Leagues, the same distance as at the Equinoctiall, then which there is nothing more contrary to truth; For all Meridians according to the Sphearical body of the Globe, must intersecting the Equinoctial at right Angles, and distant from each other at those two Intersections 100 Leagues, must needs at the Latitude of sixty degrees where the Circular Parallel is but halfe the Magnitude of the Equinoctial: and so to conclude with truth, those two Ships are now bnt fifty Leagues distant from each other. The due proportion that all Parallels have to the Equinoctial and Meridian in all Latitudes is too curious a worke for many men to perform;yet for the love wch I beare in general to all the practizers of this Art, I have with the expence of a great deal of pains already calculated two small Tables which will appear in the ensuing worke, whereby the meanest Mariner shall be able at first sight to resolve the proportion of all Parallels, in respect of the Equinoctial and Meridian;as likewise the differences of their Longitudes both in Leagues, Miles, and Paces : Thus much of the Terrestial Globe, with all manner of Circles described upon him, which if they be judicially observed, is as much as is possible to be demonstrated, and will sufficiently satisfie any reasonable capacity for the full understanding of the whole Terrestial Globe in all his particular Circles of several qualities.

Of Latitude.

LAtitude importeth as much as breadth, being alwayes that Portion of the Meridian, which is contained betwixt two Parallels, the Equinoctial being ever one, and your point being the other; for if a Parallel were extended from the point of your being untill it made a whole Circle, and joyned again in your first point, you might runne all the degrees of that Circles Longitude untill you arrive again at the first point: And never alter one minute of your first Latitude.

Of finding the Latitude.

AFter the Practitioner of Navigation, hath throughly understood all the Principles, which are afore-mentioned, I hold it convenient that he should now use his endeavour to take the Altitude of bodies scituated in the Heavens, as (Sunne and Starres) by which Altitudes he shall most facilly finde the Latitude or breadth which he is in, for the handling of your Geometrical Quadrat, Astrolabe, Crosse-staffe, or such like Instruments, in time of observation is so facill, that at the first sight common sense cannot but conceive it; therefore I will of purpose omit that matter, and proceed to the manner of worke after the Altitude is gained. Now then to attain this Latitude or portion of the Meridian contained betwixt your Parallel and the Equinoctial, you must be very circumspect in observing these three things: First, the Altitude of the Sunne according to the side of the Angle given by your Geometrical Instrument: Secondly, that you know the declination of the Sunne for that day, when he intersecteth the Meridian: Thirdly, that you have a speciall care to consider the scituation of your Zenith point, in regard of the body observed (of which point) it must alwayes (if you have Latitude) be found in one of these three respects; First, either the Sunne is betwixt your Zenith, and the Equinoctial, or else

elſe the Equinoctial is betwixt the Sunne and your Zenith ; or Thirdly , your Zenith is betwixt the Sunne and the Equinoctial. Now theſe three different ſcituations of your Zeniths maketh three ſeverall ſorts of working to finde the Latitude , after you have obſerved the Altitude , which by Examples of each ſeveral ſcituation I will here make plain, with the manner of worke, very eaſie to be underſtood by the meaneſt Capacity, if he will but take ſome ſmall paines to conceive the reaſon of the worke produced by Zenith diſtance and declination rightly applyed.

Firſt Queſtion.

I Demand , how I ſhall give the Latitude here at *London* the 11th day of *June* , according to the Altitude of the Sun obſerved.

Here I conſider by my *Ephemerides* , or by the common Tables calculated , that the Sunne hath to day 23 degrees, 30 minutes North declination, when he is due South, or upon her Meridian.

Then I conſider the ſcituation of my Zenith point , and I finde that the Sun is betwixt it and the Equinoctial.

Wherefore now I take my Geometrical Inſtrument , when I finde the Sunne almoſt South , or upon his Meridian , and continue obſerving untill I have him at the greateſt Altitude ; which here admit I finde, is 61 degrees, 58 minutes, which Altitude I ſubſtract from 90 degrees, 00 minutes, and have remaining 28 degrees, two min. Therefore I conclude , that is the diſtance of the Sunne to day from my Zenith point. And in regard I finde the Sunne hath to day North declination, and that my Zenith point is ſcituated, containing the Sun betwixt it and the Equinoctial, I joyne my declination and my Zenith diſtance from the Sun into one ſumme , which I ſay is the true Latitude or breadth of *London* from the *Equinoctial.*

Manner of works.

	deg.	min.
THe quantity of your Quadrat, is alwayes	90—	00
The Altitude found by observation to day, is	61—	58
Which Alt. subtr. the remainer is the Zenith distance,	28—	02
Declination of the Sunne to day, is	23—	30
Wch being joyned to the Zenith distance, the Lat. is	51—	32

This Rule holdeth in all Latitudes of like scituation, and serveth for ever in this Latitude and all others that are more Northerly then 23 deg. 30 min. provided the Sun have North declination when you observe his Altitude.

Now you may very easily conceive by this question, that you have to day the greatest Altitude of the Sunne that you can possibly have in this Latitude of 51 degrees 32 minutes, because the Sunne to day is in the Tropick of *Cancer*, and hath made her greatest North declination, which is 23 degrees 40 min. so the Sunne is but 28 degrees 2 minutes distant from your Zenith point, which if you substract from 90 deg. 00 minutes, the distance of your Zenith from the Horizon, the Suns Altitude appeareth to be 61 deg. 58 min. higher then which you shall never finde her, here at *London*.

Second Question.

I Demand, how I shall give the Latitude here at *London* the twelfth day of *December*, according to the Altitude observed.

First, I consider the Suns declination for the day, and finde it 23 deg. 30 min. to the South-ward of the Equinoctial.

Secondly, I consider the scituation of my Zenith point, and finde the Equinoctial is betwixt the Sun and my Zenith, because the Sun hath South declination, and my place of being is to the North-ward of the Line.

Wherefore now I take the Meridian Altitude with my Geometrical

metrical Inſtrument as afore, which admit I finde to be **14** deg. **58** minutes, which I ſubtract from **90** deg. **00** min. the whole Quadrat, and there reſteth **75** deg. **2** min. which I ſay is the diſtance of the Sunne from my Zenith : And now becauſe the Sunne hath **23** deg. **30** minutes South declination. I ſubtract it from my Zenith diſtance, **75** deg. **2** minutes, and there reſteth **51** deg. **32** min. which I conclude is the Latitude deſired.

Manner of Works.

	deg.	min.
The whole quantity of your Quadrat, is always	90	00
The Altitude found by obſervation, is	14	58
The Zenith diſtance is,	75	02
The declination of the Sun is	23	30
Weh being ſubtr. from the Zenith diſtance, the Lat. is	51	32

By this queſtion, it appeareth plain that the Meridiona Altitude of the Sunne to day being **14** degrees **58** min. is the leaſt that is poſſible for you to have in this Latitude, becauſe the Sunne to day is in the Tropick of *Capricorn*, and hath made her greateſt South declination, which is **23** degrees, **30** minutes.

Take this brief Rule for all places, having your Zenith ſcituated as afore, that if the Sunne hath South Declination, you ſubtract the declination from your Zenith diſtance, and the remainer is the Latitude : But if the Sunne have North declination, joyn the declination from your *Zenith* diſtance, and the product is the Latitude deſired.

Thus have you the way to finde the Latitude according to the ſcituation of two of the three Zeniths, by obſervation of the Sunnes Meridional Altitude. Now for the third, you may conceive it can never happen, but when your being is betwixt one of the Tropicks and the Equinoctial ; for except you are within **23** degrees, **30** min. of the Line, it is impoſſible to have your *Zenith* betwixt the Sun and the Equinoctial ; but
finding

finding your *Zenith* so scituated, you must proceed to finde the Latitude of the place by the Altitude observed, in this manner ; substract your *Zenith* distance from the declination of the Sun that day, and the remainer is the Latitude or breadth from the Equinoctial desired.

Third Question.

I Demand, how I shall give the Latitude of St. *Christophers* Island the 12th day of *June,* according to the Altitude of the Sun observed.

First, seek the declination of the Sunne for that day, and you will finde it 23 degrees, 30 min. to the North-wards of the Line.

Then consider the scituation of your *Zenith Point*, which will appear to be betwixt the Sunne and the Equinoctial. Now take your Geometrical Instrument, and observe the Suns Altitude, which admit, you finde him upon the Meridian of 84 degrees 00 min. above the Horizon, which I subtract out of 90 degrees, 00 min. and finde the Sun distant from my *Zenith,* 6 deg. 0 min. Therefore now according to the Rule, subtract 6 degrees 0 min. from 23 deg. 30 min. the declination of the Sunne that day, and the Latitude or breadth that St. *Christophers* is from the Equinoctial remaineth, which is 17 deg. 30 min.

Manner of Worke.

	deg.	min
THe whole quantity of your Quadrat, is	90	00
The Altitude found by observation, is	84	00
The *Zenith* distance, is	6	00
The declination of the Sun, is	23	30
The *Zenith* distance subtr. from the declination Lat.	17	30

Having the Sunne or Perpendicular in any place found by observation, the declination of the Sunne is the Latitude of

the

the place : But if when you have the Sunne in your *Zenith*
Point , your Ephemerides or calculated Tables giveth no de-
clination, then conclude, that the Equinoctial Circle runneth
through your *Zenith* Point, and that you are in no Latitude or
breadth from the Equinoctial , becaufe you are juft under it.

The reafon of taking Altitudes.

HAving fhewed the manner of working your obfervations
of the Sunne ; howfoever your *Zenith* point is fcituated,
whereby you may come to the true knowledge of your
Latitude or breadth from the Equinoctial and Poles , it now
refteth , that I fhould fhew reafon for that which is produced
by the operation of your Geometrical Inftrments ; therefore
you muft in the firft place conceive the Nature and quality of
your Inftrument , with which you obferve , or take the Alti-
tude. Know then that all manner of Inftruments, of what form
foever projected, as Crofs-ftaves, Back-ftaves, Quadrats , A-
ftrolabes, &c. are all of them according to Geometrical meafu-
ring the exact fourth part of a Circle containing 90 degrees, 00
min. and refolving by their Angles the fame thing that the Qua-
drat and Aftrolabe doth with their Arches. Now then if we
define the Nature of obfervation by the Geometrical Arch, the
reafon of all obfervations of Altitudes taken with any kind of
Inftrument, will be explained.

First then, *Quadrant* fignifieth a Square and Arcuffe, a por-
tion or part of a Circle ; which if it be fwept in a Square or e-
qual Paralelograms, one foot of your Compaffes ftanding in
any of his interfections, and the other extended the length of
either his fides, making that diftance his *Seme-diameter* , the
Arch is as great as poffible may be contained in fuch a Square ;
And a fubtending fide or bafe being drawn from the extream
interfections of the Arch with the fides, will make the Square
equall to two Right-angled *Ifofcheles* , as this Figure repre-
fenteth.

The

The Figure.
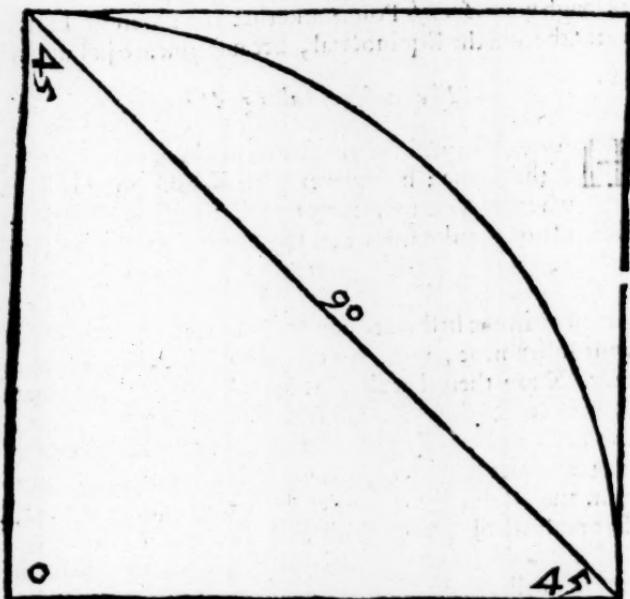
Now then it is plain, that the Right-angle of *Ifofcheles* is alwayes equall to his fub-tending Side or Bafe, which here you fee interfecteth the Arch, and the two containing fides at two places, and maketh his two Acute or fharp Angles, equall 45 a piece, fo you fee the Arch is equall to the Right-angle, and the two Acute Angles will make another Arch of like quantity, which being adjoyned, is an exact *Semi-circle*, fo then it refteth, that the Quadrant ufed in obfervation, is the greateft Arch of a Circle that is pofsible to be defcribed within an equal Paralelogram, which will alwayes be the exact fourth part, if your Paralelogram bee without fault, and therefore

therefore is very properly called a *Quadrans.* Therefore now finding that my Geometricall Arch, which I obſerve withall is equall to the Right-angle of *Iſoſcheles* it may moſt eaſily draw theſe Imaginations into your mind.

First,

THat in what place ſoever you are, either on ſhoare or at Sea, that the point which you reſt upon is the Center of a Semi-circle, and the oppoſite point in the Heavens is your Zenith, from whence if a Perpendicular line were let fall, it would be the Semi-diameter of the Semi-circle.

Secondly,

THat being thus in the Center with your Zenith Perpendicular, you can turne no way, but if you obſerve your viſuall Line to the Horizon, and remember your Zenith Perpendicular the Arch of the Heavens contained is equall to your Geometricall Arch projected,

Thirdly,

THat there is nothing contained within your Horizontall Circle, whether it be in the Heavens, or ariſe from your Superficies, except onely your Zenith Point, but your viſuall Line will ſhew that it is a part or portion of the contained Arch.

Fourthly,

THat all viſuall Lines except your Zenith and Horizon, interſecteth an Accute or Sharpe Angle with your place of being or Center.

Fiftly,

THat this Accute or ſharpe Angle being once knowne, which your viſuall line maketh with any body obſerved, and that you ſuppoſe a Perpendicular line to fall from the interſection of the body (and viſuall Line) to the Superficies

where-

Wherein you are, that perpendicular is the Altitude of the body, and will interſect your Horizontall viſuall line, at a right Angle, and the viſual line at the body with an Acute or ſharpe Angle, which is alwayes in the quantity as muuh as the knowne Acute wanteth of 90 deg. co min. and is the exact diſtance of the body obſerved from your Zenith Point.

Sixtly,

SIxtly and laſtly, you may now plainly perceive, that I can ob-ſerve the Altitude of no viſuall body with any Geometricall Inſtrument, but if you obſerve the former reaſons you will have a Right Angled Triangle given with all his Angles knowne : becauſe your Inſtrument will give the viſuall Acute Angle from your Cenrer to the body, aud then the other Acute in his complement or ſo much as it wanteth of 90 deg. 00 min. (and the third is alvvays a Right-angle) ſo that if an expert Artiſt ſhould demand a reaſon of your obſervation, you may anſvver him, that you are to reſolve a right-angled _Scalenum_ ; except you find a Zenith Altitude, and then you ſhall have a Right-angled _Iſoſcheles_.

Zenith.

Scalenum. Iſoſcheles.

Scalenum.

Horizon.   Center.   Horizon.
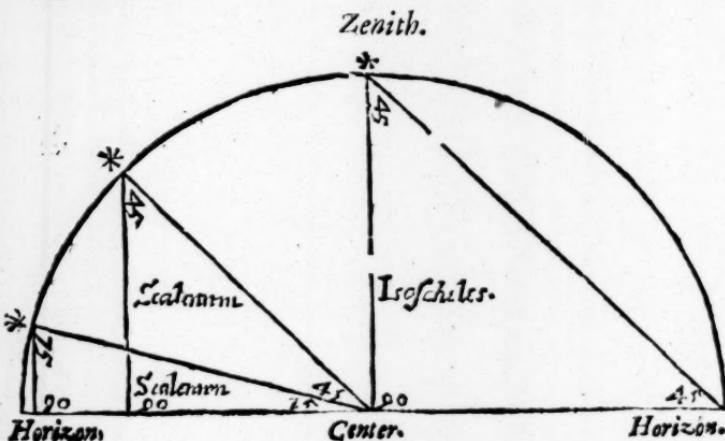
This Figure sheweth all plaine if well observed, which before was but imagined: and if you consider it a right, and according to my intent you may proceed and take your observations (not as commonly they are taken) but according to an Artist, knowing what you have done.

Of the Plain-Card.

AFter all the afore-mentioned matters of Navigation are fully understood by the Industrious Practitioner, the Plain-Card would most willingly produce his operations, but in regard his Lineaments will not answer the reall truth in the prosecution of long Voyages, I would not have your expectations frustrated with relying over-much upon his conclusions; for there are many facill and farre better wayes of accompting all manner of Courses and Traverses, by the ayd of Arithmetick and the application of one of the greatest Circles described upon the Sphearicall body of the Terrestiall Globe, which hereafter in the ensuing work will be manifested; Yet I would not have any man mistake my meaning, and conceive that I utterly condemne all Charts in *Plano*, as Instruments of no consequence, for in all short Voyages I doe allow of them, yea, and highly approve of them, as the most excellent Directors. As here in the *Sleeve* or Channell betwixt the West Countrey and *France*, there is no like Instrument as the Channell Chart of the largest graduation, and likewise in the *Irish* Seas, & so upon the Coast of *Flanders*, and in generall, in all In-lets, Straights, and Channels (provided) that the Hydrographicall descriptions of the Seas, and the Geographicall of the Lands, have been laid downe by an experienced Artist, but if they have any larger extentions, I must ingeniously confesse, I shall little or nothing at all regard their directions, because it cannot appeare any thing difficult for the meanest Marriner to conceive, that according

to

to the Meridians deſcribed upon all Terreſtiall Globes, the plaine Chart will be found to be moſt intolerably falſe, for according to the Globe, all Meridians will interſect each other at the very points, which we terme the Poles, but the plain-Charts make them all to be paralels in all Latitudes, then which nothing is more falſe, and again, all the degrees of Longitude are falſe in all Latitudes, except right under the Equinoctial, becauſe the Meridians and Parallels hold not their proportions as they ought to doe, and therefore it muſt needs be, that all Courſes or Rombes will faile in their directions. And ſo all his Lineaments will be found lame, increaſing to greateſt Errours as you are farre Northerly or Southerly, and therefore may not be over-much followed, if you will have your concluſions crown'd with credit. As for the manner of uſing your Channel-Chart is ſo facill, that at the firſt demonſtration common ſence will diſcover all his Lineaments and uſes. Therefore I will ſave the Labour of defining him in particular, referring you to any Channell-Chart that is well deſcribed, whereby you cannot be long in conceiving all his parts in generall.

Of the diſtance of Places.

TO Sayle the moſt direct Courſe betwixt any two Places Aſſigned, and to diſcover the moſt compendious or ſhorteſt diſtance in Degrees, Leagues, and Miles or any other kind of Meaſure that ſhall be deſired, will require ſome better knowledge then the uſe of the plaine Chart, with his (Parallel Meridians) and in all Parallels equall Degrees of Longitude and Latitude : For ſurely the intelligent Artiſt, cannot be ſo ſtupid as that he ſhould take the diſtance diſcovered by ſuch and Inſtrument, and conclude that it produceth the reall truth, for the afore-mentioned reaſons will ſufficiently ſatisfie, that no ſuch matter may be expected in any great diſtances : Yet I know there is many will labour much to prove the plaine Chart moſt infallible and certaine in his operations,

but

but their many lame couclusions I dare affirme, doth secretly
checke most of them in their conscience, especially if the
course have not Elevated or deprest the Poles over-fast : but
that the Longitude hath had a farre larger proportion then
the Latitude, as in many severall long Voyages I have
seen the experience and proofe of their reckonings, which
have wholly kept them according to their Plaine Charts di-
rections : Amongst many, I will recite one passage that hap-
pened whilest that I sayled with the Hollanders, which many
English and Dutch yet living will affirme to be most true, we
had two Yaughts or small Ships of the West-India Compa-
nies, aboard of whom wee had both Dutch and English Of-
ficers, that professed the Art of Navigation. Wee had our
Commission to discover the Islands of the *Luayos*, where ha-
ving beene some foure Moneths in very much danger, and
great store of foule weather, we found that wee were some-
thing to the North-ward off an Island called the *Vcanes*, which
lyeth in the Latitude of 27 degrees 30 minutes, and finding that
the Golph of *Balhama* set us off to the N. E. and so haust us
out from amongst the islands, it was agreed, that we should
beare up the helme to goe Home : you must understand, that
from this Island we shap'd our course for *Flowers*, one of the
Wester Islands, lying in the Latitude of 39 deg. 30 minutes,
and to the East-ward of the *Vcanes*, according to most exact
accompt, (as I did Calculate) 800 English Leagues, but by
the Plaine Charts much more, when wee first stood away
our course from amongst the Islands, I then told all those that
kept their accompts according to the Charts in *Plano*, that
by this runne of so many hundred Leagues, and raising the
Pole not above 12 degrees 00 min. they should plainely per-
ceive the Errours of the Instrument ; but because most of them
had no other meanes to helpe themselves, they stood in his
justification, and onely I in his Condemnation, wee pro-
ceeded in the course, and kept all our accounts most secret
from each other, untill the matter came to be discovered, for
when I had runne out the Leagues of Longitude, contained

be

bet wixt the afore-said places, according to my calculation, I did not use the old Sea-course of keeping my account secret untill we saw the Land, for then I well knew there would be no bad rekonings produced, but according to my observation finding that my Latitude and Longitude had transported me very neare the place of expectation: about setting of our watch I plainly and openly spoke, that if the Gale held but so as it did untill morning, we should be close aboard the Islands of *Flowers* and *Cornes*; these speeches thus spoken, made a mighty confusion amongst all our Artists, in general, so that some of them hoping to have had the credit of the case openly affirmed against me that it was impossible to be so neer the Land, and that wee must ruune yet 150 Dutch miles, which is 200 English Leagues before we should see the Land and so they all in generall concluded wee were so farre distant, some of them being 150 Dutch miles, some 140 some 120 but none of them neerer in the Night time we spoke with our consort, and it was quickly advertised what I had said: but he held it impossible, and concluded neare upon the same matter as they did aboard us, and so I was condemned of them all in generall. Yet there were some English and Dutch, that having little knowledge themselves, did rely more confident in my conclusiou, because in former affaires they had bin eye-witnesses that they had truly answered their expectations, whereupon the matter grevv to wagers, with much advantage against me; it vvas strange to see how resolute they were against their reputations, and how obstinare in their opinions: Yet were not able to render a reason, the Morning came and it was very heafie untill bewixt 9 and 10 of the clock when it cleared up, and novv you may be sure the tops would not want some to looke abroad: the first that adventured saved the rest a labour, and shewed us Land right a head about some three Leagues off, to confirme the truth of the matter, wee did but step forward and uuder the Litch of the Fore-fayle were eye-vvitnesses, as any man that knovveth those Lands vvill easily conjecture, that it must be very thicke vveather, if at that distance vve should

not

not difcover them upon our decks : this reall truth produced, made them all fall a wrangling at their Charts as moft erronious and falfe, and now the moft intelligent men began to defire meanes for the amendment of fo groffe a fault, upon which occafion, I did then promife, that if occafions would permit, ere it were long they fhould have the fame way of accompt, which I ufed for all manner of Voyages, fo plainly difcovered both to them and all others, that if the Courfe were never fo long and difficult, in regard of fhifts of winds and traverfes, yet the true point of the Ships being fhould be certainly knowne, to the Induftrious Practitioner how it was Scituated, in refpect of all parts upon the Terreftiall Globe. This hath and is the chiefe caufe that the enfuing Work is now divulged to publicke view, for I could well have kept it as yet in my owne breft to my particular benefit, and faved a great deale of Labour in unlocking and lying open all my Treafure to bee freely fhared amongft my Friends. But that I have ever held my promife if poffible fhould be performed. And now I heartily wifh, that although I have difperfed the Key in common amongft them, that they may all find an everlafting Treafure to fatisfie their expectations.

CHAP. I.

The Way of Sayling by the Arch of the greatest Circle extended.

THE most excellent way of Sayling , is by the Arch of one of the great Circles applyed or extended, betwixt any two places upon the Terreſtiall Globe, by which directions you will not onely fayle the moſt compendious courſe that is poſſible , but ſhall likewiſe be able to keepe a more exact accompt of all manner of courſes that you can by any other kind of meanes , and ſhall be aſſured of the certaine point of your ſhips being. But it is moſt neceſſary before you proceed to the manner of worke , that you ſhould underſtand the Nature of all Courſes betwixt any two places aſſigned : Therefore the intelligent Artiſt cannot but conceive at the firſt ſight of any Terreſtiall Globe , that all places hovvſoever ſcituated muſt in reſpect of the Sphericall body , containe a part or portion of a Circle betwixt them.   Now then the greater Diameter that the Circle hath , the leſt Curve or crooked will his Arches be. Therefore if wee will find the moſt direct Courſe, it muſt be performed by one of the greateſt Circles deſcribed upon the Globe , and extended betwixt any tvvo places aſſigned ; which extention and none other will give you the exact quantity of Degrees, Leagues , or Miles, that is contained betwixt them , as it appeareth by the graduated Quadrant belonging to all Globes , which is the exact fourth

part

part of the Meridian or Equinoctial, which are Circles of the greatest capacities; that Quadrant being extended betwixt any two places, sheweth the true distance; But to find the portion or part contained without the Terrestrial Globe, will require the consideration of divers matters. And because, it is most proper to explaine their reasons before the operation, that the judicious practitioner may be assured in the certainty of his Conclusions; therefore we will begin, and first take into our consideration the nature of all Diameters and Semidiameters.

Diameters and Semidiameters.

ALL Diameters and Semidiameters of the Globe, bear proportion each to other, and the same proportion that one Diameter or Semidiameter beareth in respect of another, the same proportion will their Circumferences have to each other.

The Signes of Latitude.

THe signes of any Latitude, are the perpendiculars that are supposed to be let fall from any Degree of the graduated Meridian in the terrestial Globe, and doth intersect the Diameter of the Equinoctial at right Angles: and the signe of the Complement of any Latitude, is a perpendicular, that is supposed to intersect the Diameter of the Meridian at right Angles, and is ever the Semidiameter of that Parallel.

Parallels.

THe Signes of all manner of Latitudes being Perpendiculars, intersecting the Diameter of the Equinoctial at right Angles, must of necessity be Parallels to each other, and so are likewise the Signes of their Complements.

<center>L</center>

Propo

Proportion of Circles.

ALL Parallel Circles upon the terreſtial Globe hold a certaine proportion with the Meridian, and theſame proportion that the Parallel hath to the Meridian, the ſame proportion will their Diameters and Semidiameters bear each to other.

As for example, in the Parallel or Latitude of 60 degrees, 00 minutes, the whole Circle is but halfe ſo bigge as the Meridian; and therefore, a Degree of that Parallel is but halfe the Magnitude of a Degree in the Meridian, and ſo in like manner, the ſigne of the complement of that Latitude, or the Semidiameter of the Parallel, is but halfe the quantity of the Semidiameter of the Meridian.

Circular Courſes.

THere is no Rombe or Courſe which you can ſteere, by the direction of any of the points of the Compaſſe, which will tranſport you the neereſt way betwixt any two places aſſigned, but onely Eaſt and Weſt right under the Equinoctial, and North and South which is under a Meridian, for all other Courſes produce not one of the greateſt Circles; and therefore the Arch contained is more curve or crooked then it would be, if an Arch of the Meridian or Equinoctial were extended betwixt them; and therefore cannot poſſible be the moſt direct Courſe that may be found.

CHAP.

CHAP. II.

The order and considerations which are
to be observed when you are to find the distance be-
twixt any two places Assigned, according to
the Arch of a great Circle
extended.

I Doe desire that you would take some little pains in thoughly acquainting your selfe with the former short Theorems or definitions, before you proceed farther into the worke. For I assure you, that they will give you so great a light perfectly to conceive and rightly to understand the true reason, that it will be well worth your labour: But to proceed in the finding out the true Distance betwixt any two places upon the Terrestial Globe, you must in the first place, provide your selfe of a Circle containing in the Diameter, about some 12 Inches, for if it be smaller, the degrees will be so little that halfe a degree will be of no consequence, which is ten Leagues in distance; therefore the larger the better, this Circle must be divided most exactly into 360 degrees equal parts, with figures set to each 5 degrees, for the readier numbring, and so proceed until it make 360 deg. which concludeth the whole Circle, as this Figure following plainly expresseth.

The

The Figure
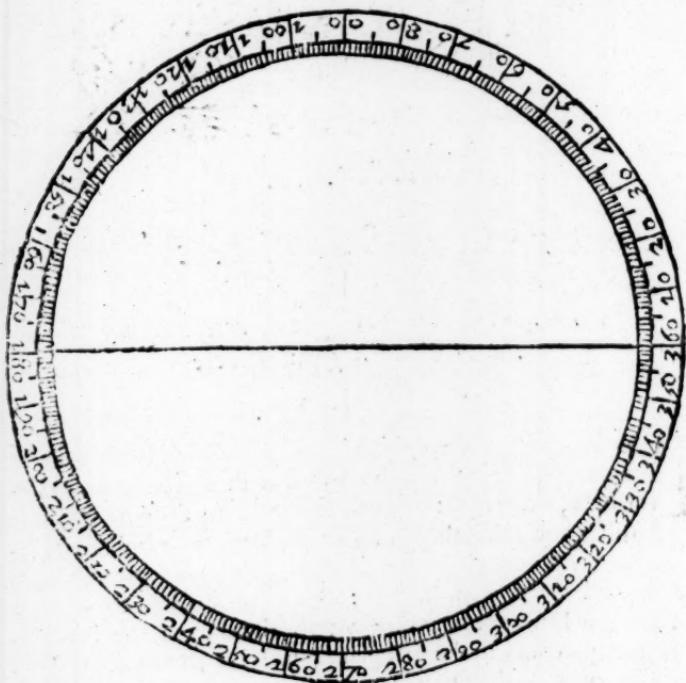
The material that it fhould confift of, fhould be of Braffe
or well plained board; but for want of thofe, you may de-
fcribe it upon good paft-board: after your Circle is compleat-
ly divided you muft underftand, that it doth reprefent the Equi-
noctial Circle defcribed upon all Globes: and therefore is a Cir-
cle of the greateft Diameter, when this eafie Inftrument is pro-
jected and framed, you may proceed and find the true diftance
betwixt any two places, if you will firft take notice of thefe fol-
lowing obfervations.

                                                                Firft,

First Observation.

FIrst, confider, that if the two places which are affigned you to give the true diftance according to the Arch of one of the greateft Circles, fhould be both of them fituated to the North-wards of the Equinoctial, and that they fhould have one and the fame Longitude, then reafon will refolve the Queftion without any farther worke, but onely fubtracting the leffer Latitude out of the greater, and the true diftance will remaine, becaufe the Arch contained betwixt them is a portion or part of the Meridian, which is a Circle of the greateft Diameter, therefore fheweth the true diftance : As for Example.

Queftion.

I Demand, the true diftance according to the Arch of one of the greateft Circles that is contained betwixt the Ifland called *Ife-land*, and the Ifland called *Fero*, one of the *Canarie* Iflands.

Here in this queftion, firft, I confider that both places lye in Northerly Latitude, namely, *Ifeland* in 66 deg. 00 min. and *Fero* in 28 deg. 00 min, then I confider the Longitudes of the afore-faid places, and it appeareth, that they are both fituated under one Meridian which is a Circle of the greateft Diameter; Therefore according to the former directions, I fubtract the leffer Latitude out of the greater, and the Arch contained betwixt them remaineth : As for Example.

	deg.	min.
The Latitude of *Ifeland*, is	66	00
The Latitude of *Fero*, is	28	00
Refteth after fubtraction	38	00

So it plainely appeareth, that the true diftance betwixt *Ifeland* and *Fero*, according to the Arch of one of the great Circles contained betwixt them is 38 deg. 00 min. which is

is foon turned into Leagues or Miles, onely by multiplication; for if you multiply 38 degrees, 00 minutes; by 20, which are the Leagues in one degree. either of the Equinoctial or Meridian, the product yieldeth the leagues contained betwixt the afore-faid places¦, and if you multiply thofe leagues by 3, you have the Miles; therefore it is moft manifeft that *Ifeland*, is diftant from *Fero*, one of the *Canary* Ilands, 38 degrees, 00 minutes of the Meridian, or 760 leagues, or 2280 Miles.

Second Confideration.

SEcondly, you muft confider, that if two places be affigned you to give the true diftance according to the Arch of one of the great Circles contained betwixt them, and that one place lyeth to the Southward of the Line, and the other place is fituated to the North-wards of the Equinoctial, and yet that both of them fhould have one Meridian; then onely adde the Latitudes of both places into one fumme, you have the true diftance in degrees and minutes, which you may turne into degrees or Miles as I fhewed before, and by the following Queftion is manifefted.

Queftion.

I Demand the diftance, according to an Arch of one of the greateft Circles, that is contained betwixt *Fayal*, one of the Wefter Ilands, and Cape *Frio* in *Brazeel*.

In this Queftion, I firft confider the Latitude of both places, and I find that *Fayal* is fituated in the Parallel or Latitude of 39 degrees, 00 minutes, to the North-ward of the Equinoctial, and that Cape *Frio* in *Brazeel*, hath 22 degrees, 00 minutes of South Latitude, now in regard both places have one and the fame Longitude, I onely adde or joyne both Latitudes into one fumme, and I have the degrees of the Meridian that is contained betwixt them: As for Example,

Fayal

	deg.	min.
Fayal hath North Latitude ————————————	39	00
Cape *Frio* hath South Latitude ———————————	22	00
Both added into one summe maketh —————————	61	00

Which is the true distance in degrees of the Meridian or Equinoctial, that is contained betwixt the aforesaid places, which turned into Leagues, maketh 1220, and in Miles amounteth to 3660.

Third Consideration.

THirdly, you must consider, that if any two places be assigned to give the Arch of one of the greatest Circles contained betwixt them, and consequently they are true, and that both places are situated right under the Equinoctial, then you may onely observe the difference of their Longitudes, and that is their true distance; because the Equinoctial is a Circle of the greatest Diameter, but you must ever note, that if the degrees of Longitude amount to more then 180, then subtract them from 360, and the true distance of degrees contained betwixt the aforesaid places will remaine: As for Example.

Question.

I Demand the distance, betwixt St. *Thomas* Iland, which lyeth right under the Equinoctial, admitting that it hath 35 degrees, 00 minutes of East Longitude, accounting from the Meridian that passeth by the Ilands of Cape *Deverte*, and the mouth of the River of *Amazones*, which is likewise situated under the Equinoctial, and is allowed to have 325 degrees of Longitude, acounting from the afore-said Meridian.

Here in this Question, I onely note the difference of Longitude, and it appeareth that St. *Thomas* Iland hath 35 degrees, 00 minutes of East Longitude; which because all degrees of

<div align="right">Longi-</div>

Longitude, which because all degrees of Longitude ever begin their first account Eastward, I onely reserve that summe until I have subtracted, 325 deg. the Longitude of the River of *Amazones*, from 360 deg. the beginning and ending of all Longitudes, and there remaineth also 35 deg. 00 minutes, which I adjoyne to the 35 deg. 00 min. of East Longitude, where St. *Thomas* Iland is scituated, and they both make 60 deg. 00 min. which being turned into leagues, make 1200, and in Miles amount to 3600, which is the true distance of the aforesaid places according to the plaine of the Equinoctial extended betwixt them, which is a Circle of the greatest Diameter: All these Questions hitherunto, have no difficulty in finding the Arch of the Circle contained betwixt them, because their proper courses are all of them under Circles of the greatest Diameters, and therefore are soon resolved, onely with the help of Addition and Subtraction; Yet I could not omit them as matters of no consequence, in regard I am certaine the Industrious Practitioner doth ever desire fully to understand every particular as he proceedeth.

CHAP. III.

How to find the true distance, according
to the Arch of a Circle extended betwixt any two places, howsoever Scituated.

After all the former considerations are fully understood, you may proceed by the aid of your great Circle formerly described, and take the true distance that is, contained betwixt any two places howso-

howſoever ſituated; the firſt thing that you muſt take in
hand whereby you may proſecute the premiſſes , is the gra-
duated Circle , containing 360 degrees ; from the Center of
which Circle you muſt take betwixt a paire of Compaſſes
the exact Semidiameter , accounting from the Interſection
with the out-ward-moſt Circle of the two, that containeth the
ſingle deg.betwixt them , and with the ſame extention upon a-
ny plain and cleane ſheet of paper , ſweep another Circle of
the ſame magnitude ; then take your ruler and draw a Dia-
meter at pleaſure , running directly through the Center ; at
the Interſection of this Diameter with the circumference , ever
towards the right hand , ſet in figures 360 degrees, repreſent-
ing the beginning and ending of all manner of Longitudes,
and ſo you are now compleatly ready to reſolve any kind of
diſtance that you ſhall deſire , if you obſerve the nature of
the ſituation of both places , which may be in four ſeveral re-
ſpects or kinds , which I will here briefly explaine , that the
judicious Practitioner may not at any time be deceived in mi-
ſtaking the manner of work , for he muſt underſtand that upon
theſe four ſeveral ſituations , there ariſeth four ſeveral ſorts of
worke, which if you ſhould miſtake one for another , it would
breed great Errour and ſhame to your concluſions ; but if you
will carefully mind the manner of worke , which is hereafter
obſerved upon the general ſituations, you will never faile, for
you may aſſure your ſelfe that there can no Queſtion happen,
but it will either fall out according to one of theſe four Situa-
tions, or elſe in reſpect of the already conſiderations formerly
manifeſted.

Firſt Situation.

FIrſt , one place may be right under the Equinoctial, and ſo
hath no Latitude , and yet may be in many ſeveral degrees
of Longitude , accounting from the Meridian that interſecteth
the Equinoctial at 360 deg. which is the beginning and en-
ding of all manner of Longitudes , and the other place may

have

have both Latitude and Longitude, yet differing from the first
places Longitude.

Second Situation.

SEcondly, two places may differ both in Latitude and Longi-
tude, and yet may be both of them situated either to the
North-wards or South-wards of the Equinoctial.

Third Situation.

THirdly, two places may differ both in Latitude and Longi-
tude, and one place may be situated to the South-ward of the
Equinoctial, and the other to the North-ward.

Fourth Situation.

FOurthly, there may be two places situated in divers Paral-
lels or Latitudes betwixt the Articke and Antarticke Poles,
that may both of them have one Degree and Minute of Latitude,
yet may have several degrees of Longitudes.

These are the situations of all places upon the Terrestial
Globe, so that there cannot be any two places but in respect
of each other, they will be found in one of these four kinds,
except they fall in the former Considerations, which have been
at large explained unto you; therefore, if you will seriously ob-
serve these short directions, and then if you make application
at all times, according to the manner of work performed in the
following questions, you shall never have your expectation de-
ceived.

First Question, according to the first Situation.

I Demand, the distance betwixt the Easter-most part of the
mouth of the great River of *Amazones*, which is situated
right

right under the Equinoctial in the Longitude of 325 degrees, and the Head-land in the West of *England,* called the *Lyzard,* situated in the Latitude of 50 deg. 00 min. and 16 deg. 00 minutes of Longitude.

Now it is most apparent, that these two places are according to the first Situation, and therefore the manner of worke in this *Question,* will serve as an Example for all other of like Nature. First, then having swept a Circle of the same magnitude that your graduated Arch is of, draw a Diameter through the Center (at pleasure,) intersecting the circumference at two certaine places, the one towards your left hand, and the other towards your right; and the end of that intersection which is towards your right hand, set in figures 360 degrees, representing the beginning and ending of Longitude, then consider the Longitude and Latitude of both places severally, and you will find the Longitude of the River of *Amazones,* is 325 degrees; but because it is situated right under the Equinoctial, you need not draw any Diameter from the point of Longitude, onely set one foot of your Compasses right in the intersection of the Diameter, with the out-ward-most Circle of the two in your graduated Arch, (that containeth the single degrees betwixt them) and where you see 360 degrees annexed, extending the other foot down-wards in the same Circle, until it cut just the degrees of 325 degrees, the Longitude of the place assigned, now keep the same extention, and transferre it into the plain Circles, which formerly you drew of the same magnitude, setting one foot of the Compasses in the intersection of the Diameter, with the Circumference towards the right hand, where you see 360 degrees annexed, and extending the other foot down-wards in the Circle until you have made a marke in the Arch, representing the point of Longitude of the mouth of the River of *Amazones,* and then set out against that mark the deg. of Longitude in figures, namely, 325 deg. then take your Compasses and return again to the graduated Circle, and set one foot in the former intersection, name-

ly

y where the Diameter interſecteth the out-ward-moſt Circle
on the right hand, where is ſet in figures 360 deg. then conſi-
der the *Lyzards* Longitude, which will appeare to be 16 deg.
00 minunes, therefore extend the other foot of your Compaſ-
ſes up-wards in the graduated Circle, untill it point or cut juſt
in 16 degrees, 00 minutes, now transferre that extention into
your plain Circle of the ſame magnitude, ſetting one foot in the
interſection of that Diameter, with the circumference towards
your right hand, where you ſee 360, annexed, and turn about
the other foot upwards in the Arch, and there make a mark or
point, ſetting out againſt it 19 deg. repreſenting the de-
gree of the *Lyzards* Longitude, from which mark or point,
becauſe the *Lyzard* hath alſo Latitude; you muſt draw
a Diameter running directly through the Center of the
Circle, then in regard the *Lyzard* hath Latitude, namely,
50 deg. 00 min. therefore you muſt returne again to your gra-
duated Circle, and ſetting one foot of your Compaſſes in the
former interſection, at 360 degrees extend the other up-wards
until it cut or point right with 50 degrees in the Arch, then
transferre the ſame extention into your plaine Circle, ſetting
one foot of the Compaſſes in the interſection of the *Lyzards*
Diameter with the Circumference; namely, where you ſee
16 degrees annexed, the point of the *Lyzards* Longitude;
and turning about the other foot, cut your plaine Arch at two
certaine places; now lay a ſtraight Ruler to thoſe cuts or
marks, and from the *Lyzards* Diameter up-wards draw a
ſtraight line, which will ſtand perpendicular as it ought,
and at the interſection which the circumference ſheweth the
point of the *Lyzards* Latitude, therefore againſt that inter-
ſection, you muſt ſet out 50 degrees, repreſenting the ſame
matter.

Now from the interſection of this perpendicular with the
Lyzards Diameter, extend the Compaſſes untill one foot
ſtanding in that interſection, the other foot doth point in the
Circle with 325 degrees, the point of Longitude of the River
of *Amazones*, then keeping one foot ſtill in the former in-
terſection,

interſection, turne about the other foot which pointed to
325 deg. in the Circle, and carefully keeping the ſame ex-
tention, cut or make a marke in the *Lizards* Diameter, then
lay a ſtraight ruler from that marke to the *Lizards* point of
Latitude in the Circle, namely, where you ſee 50 deg. annexed,
and draw a ſtreight line betwixt thoſe two places, which is the
ſubtending ſide or diſtance deſired: therefore taking the length
of that line betwixt your Compaſſes, and aplying that extenti-
on to the graduated Circle, you will have the degrees and mi-
nutes of one of the greateſt Circles that is contained betwixt the
aforeſaid places, which if you turne into Leagues and Miles by
Multiplication, you have your full deſire; and in this Queſti-
on, you will find 66 deg, 09 min. which make 1323 Leagues,
or 3969 Miles, the manner of this work is ſo plainly expreſ-
ſed by the following Figure, that common ſenſe cannot but ea-
ſily conceive it at firſt ſight.
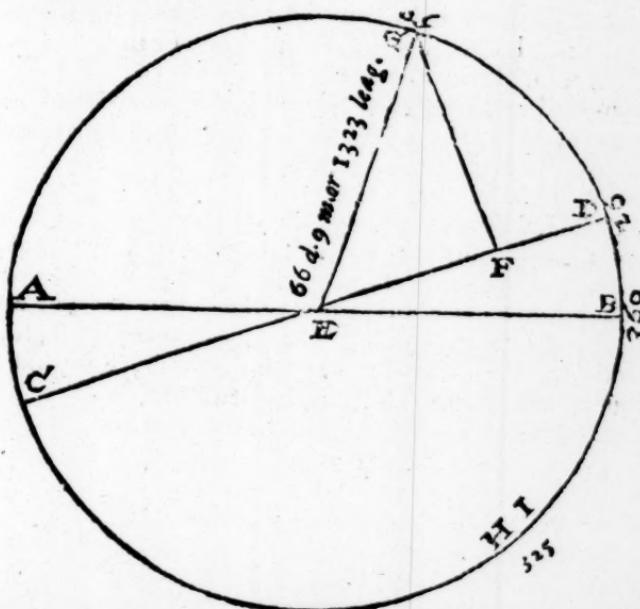
For firſt, I ſwept the whole plaine Circle exactly of the ſame bigneſſe of my graduated Arch, as hath been formerly ſhewed, then I drew a Diameter at pleaſure running through the Center, as **A B**, then at A I ſet 360 degrees, and brought from my graduated Circle betwixt my Compaſſes, the diſtance of the mouth of the River of *Amazones* Longitude, accounting from 360 degrees in my graduated Circle, and ſet one foot of my Compaſſes with the ſame extent in the Diameter at B, and with the other I cut the Arch down-wards at H, and annexed 325 degrees, the degrees of Longitude, then I brought from my graduated Circle betwixt my Compaſſes, 16 degrees, the *Lyzards* Longitude, and ſetting one foot in the interſection **x** B, with the other I cut the Arch up-ward at D, and annexed 16 degrees, the point of Longitude, and from that interſection, I drew through the Center, the Diameter D, C, then I brought from my graduated Circle 50 degrees, the Latitude of the *Lyzard*, and ſetting one foot at the interſection at D, I firſt, cut the Arch up-wards at G, and annexed 50 degrees, the point of Latitude, then keeping one foot ſtill in the interſection at D. I turned about the other foot, and cut the Arch down-ward at I, then I laid a ſtraight ruler betwixt the marks I, and G, and ſo drew the perpendicular G, F, which interſecteth the Diameter at F, then I ſet one foot of the Compaſſes in that interſection, and extended the other to the cut in the Arch at H, the point of Longitude appertaining to the River of *Amazones*; now keeping ſtill one foot in the interſection at F, I turned about the other containing the former extention, and cut the Diameter C D, at E, then I drew the line E G, which is the ſubtending ſide, or diſtance deſired, the length of which line being applyed to the graduated Arch, will yield 66 degrees, which is 1320 Leagues, or 3960 Miles.

Second Question, according to the second Situation.

I Demand the distance, betwixt the Iland in the West-*Indies* called the *Barbadoes*, lying in the Latitude of 13 d. oo min. to the North-ward of the Equinoctial, and hath 313 deg. of Longitude, and the *Head-land* in *England* called the *Lyzard*, is situated in the Latitude of 50 deg. oo min. and hath 16 deg. oo min. of Longitude.

Here, in this Question, having your plaine Circle swept with the Diameter drawne through at pleasure, as before numbred with 360 deg. at the intersection towards your right hand, consider the Longitudes of both places severally, which Longitudes with a paire of Compasses take out of your graduated, and transferre them into your plaine Circle, setting one foot alwayes at the intersection of the Diameter, towards your right hand where you see 360 deg. annexed, and with the other foot cutting the points of Longitude in the plaine Circle, as hath been shewed before, annexing the figures representing their severall degrees.

Note.

NOte, alwayes, that you cut the points of Longitude in your plaine Circle; after the same manner as you find them in the graduated; that is to say, if the point of Longitude exceed 180 d. then you must cut that part of the Circle which is downwards from the Diameter, but if Lesse then up-wards: as in this Example, the Longitude of the *Lyzard* is 16 deg. oo min which is lesse then 180 degrees; therefore when you transferre that point of Longitude into your plaine Circle, as before, you most cut it up-wards in the Circle, also when you cut the Longitude of the *Barbadoes*, in your plaine Circle, which is 313 deg. and therefore exceedeth 180 degrees, which is a Semi-circle, you must cut that point of Longitude under

the

the arch, or down-wards from the Diameter.

All which will moſt plainly appeare, if you judiciouſly ob-
ſerve this following Figure, with the manner of worke con-
tinued.
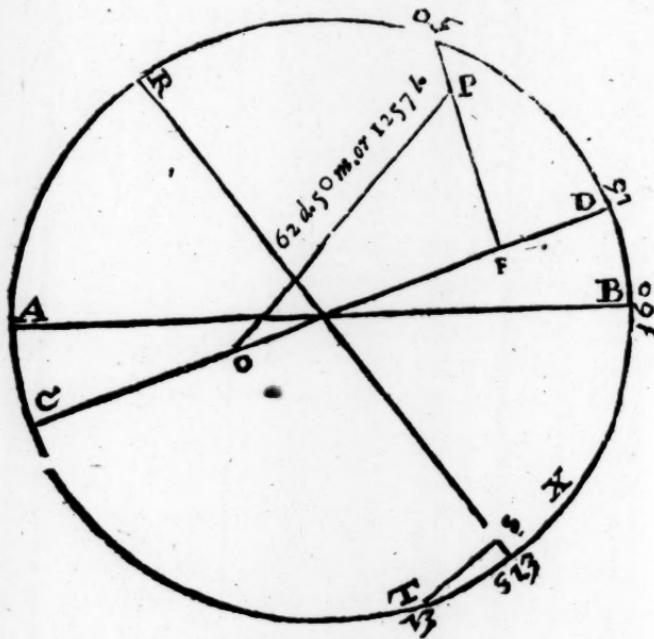
After the points of Longitude are tranſferred and cut in the
plaine Circle (as hath been ſhewed before) draw from thoſe
points of Longitude two Diameters interſecting each other in
the Center, as C D, and R S, then returne to your gra-
duated Circle, and ſet one foot of your Compaſſes in the
interſection of that Diameter, with the ourward-moſt Circle
of the two, which containeth the ſingle degrees betwixt
them
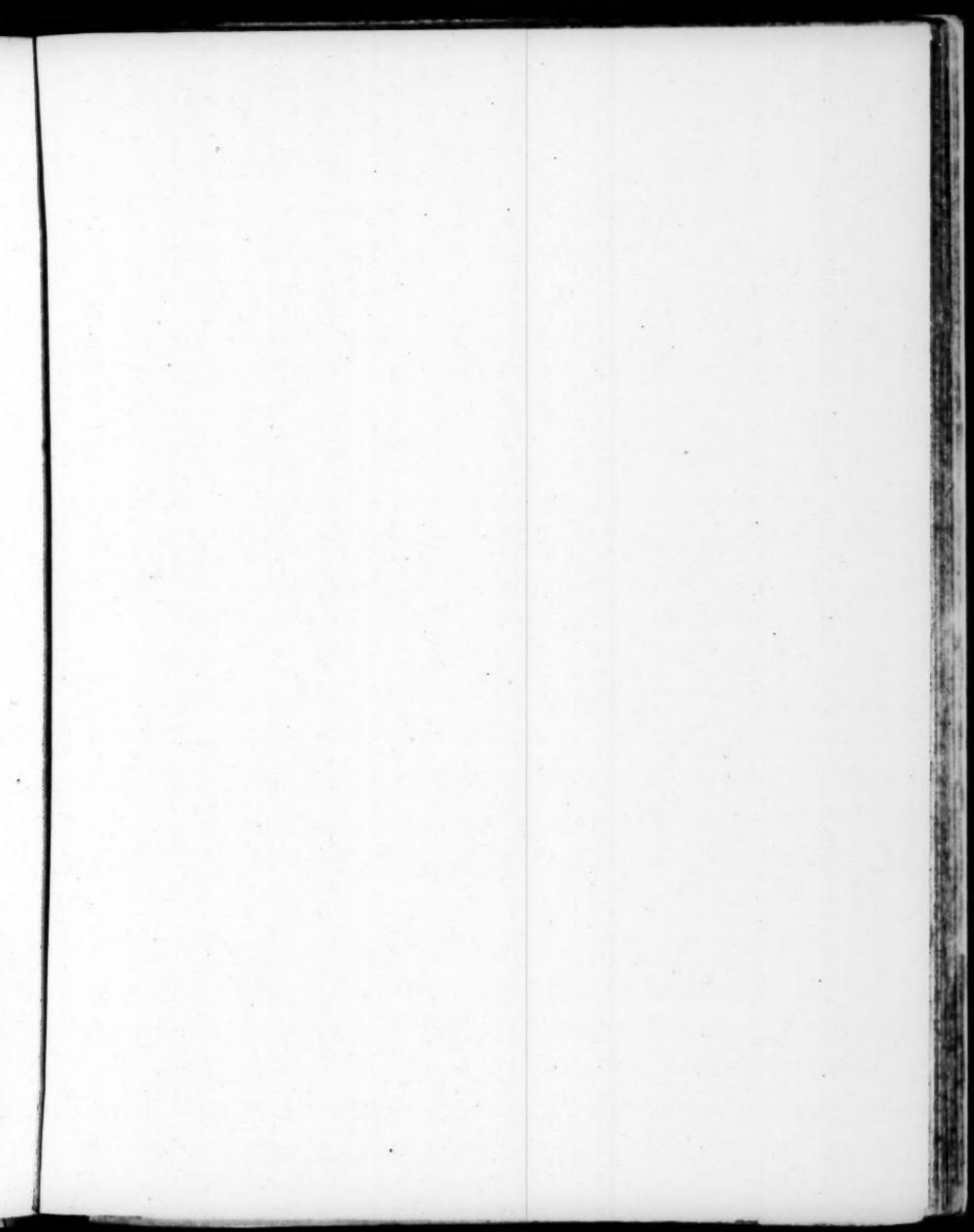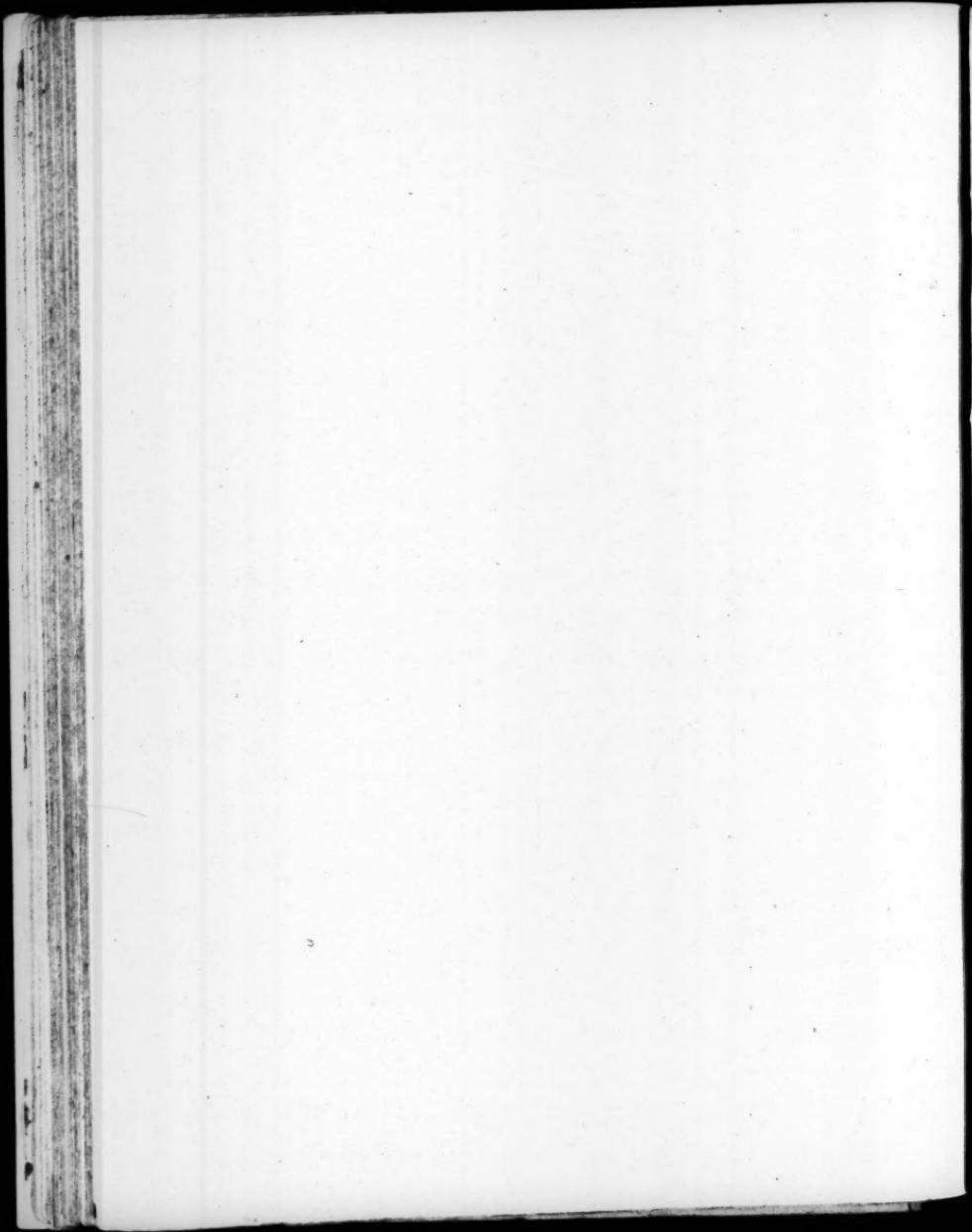
them and where 360 deg, is annexed, extending the other foot to the points of both places Latitudes (feverally) which extentions, tranferre into yonr plaine Circle making them ſtand perpendicular from their Diameters, of Longitude, and interſecting the plaine Circle at their points of figures of Latitude; as for Example, take 50 deg. betwixt your Compaſſes, the Latitude of the *Lyzard*, and with the fame extention returne to your plaine Circle, and there obſerve where the Diameter of the *Lyzards* Longitude interſecteth the plaine Arch, which you will find it at D, therefore ſet the foot of ycur Compaſſes in that interſection, and extend the other firſt upwards, and cut the Circle at G, then turne about the Compaſſes keeping ſtill one foot in the former inſection, and retaining the fame extention, cut the Arch downwards at X, then lay a ſtraight ruler to the interſections X and G, draw the perpendicular F G, which is the ſigne of the *Lyzards* Latitude, and ſtandeth perpendicular as it ought from his Diameter of Longitude; in the ſame manner, transferre 13 degr. 00 min. out of the Graduated Circle, the *Barbadoes* point of the Latitude, and make him ſtand perpendicular to his Diameter R S by cutting the Arch on both ſides with the fame extent, namely, at T X, and laying the ruler as before, both thoſe markes or points of Latitude at 13 deg. in the Arch as it ought to doe, then take betwixt your Compaſſes the Diſtance contained betwixt the interſections of both the perpendiculars with their Diameters (namely, from F to S) now let one foot ſtill reſt in the interſection of the longeſt perpendicular or greateſt Latitude (namely, at F) & then turne about the other foot holding the fame extention, and cut or make a marke in the Diameter C D at O, then take the length of the leaſt perpendicular or ſigne of Latitude, namely, I S, and transferre it into the greateſt perpendicular or ſigne of Latitude, by ſetting one foot of the Compaſſes in the interſection at G, and carrying the other downwards in the perpendicular or ſigne G F, cut the point P then draw the line O P which is the ſubtending ſide or diſtance deſired; and in this *Queſtion* if you take the di-

N   ſtance

stance O P, betwixt your Compasses and apply it to your graduated Arch, it will there yeeld you 62 degrees. 50 min. which is 1257 leagues, or 3771 miles.

Third Question is according to the third situation.

I Demand the distance, betwixt the mouth of the great River in *Brazele*, called the River of *Plate*, which lyeth in 35 degrees 00 min. of South Latitude, and in Longitude 318 deg. and the *Head-land* in *England*, called the *Lyzard*, which lyeth in 50 deg. 00 min. of North Latitude, and hath 56 deg. 00 min. of Longitude.
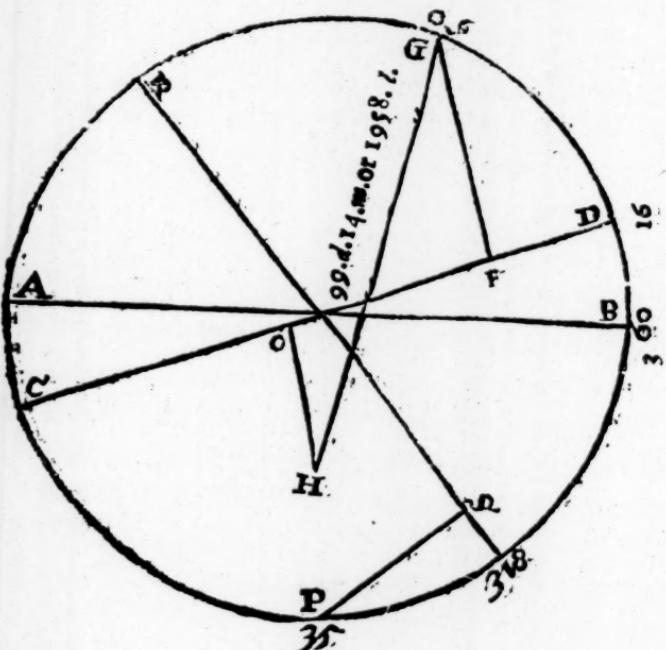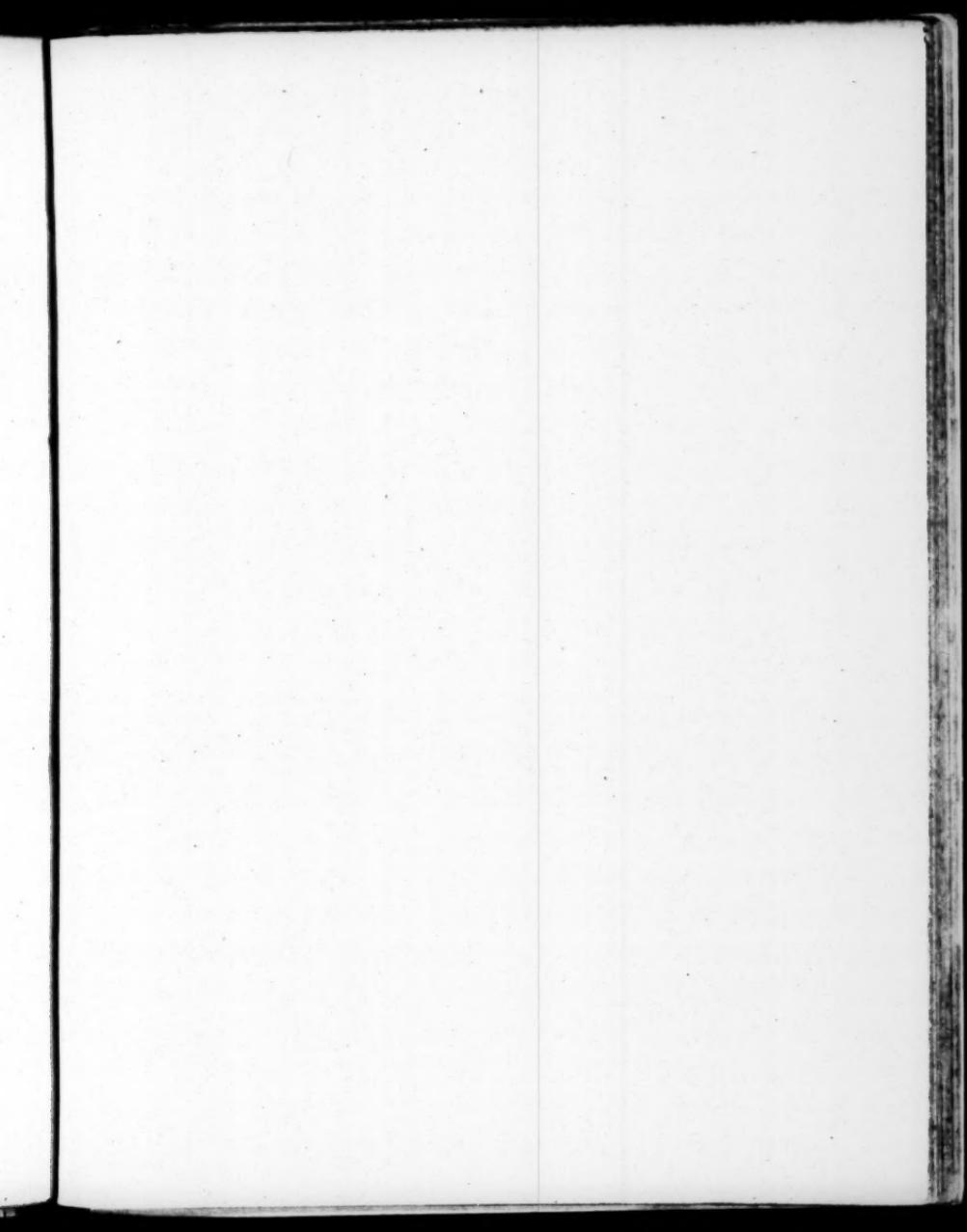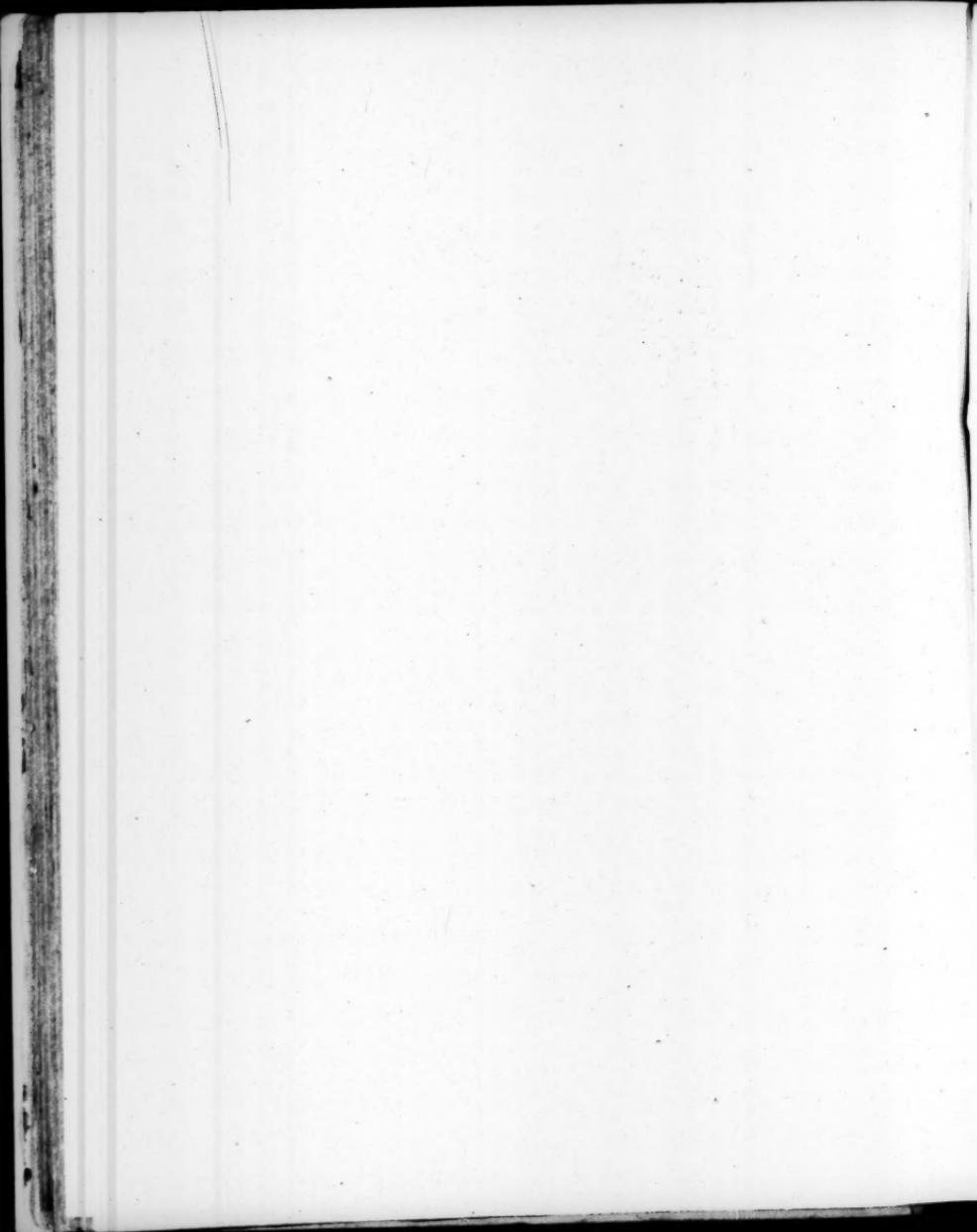
| 20 Leagues. |

Latit.	lea	M	Pac.	Latit.	lea	M	Pac.	Latit.	lea	M	Pac.
1	19	2	994	31	17	0	431	61	9	2	89
2	19	2	964	32	16	2	886	62	9	1	169
3	19	2	922	33	16	2	322	63	9	0	240
4	19	2	856	34	16	1	742	64	8	2	303
5	19	2	772	35	16	1	152	65	8	1	357
6	19	2	671	36	16	0	543	66	8	0	405
7	19	2	553	37	15	2	929	67	7	2	443
8	19	2	417	38	15	2	281	68	7	1	476
9	19	2	265	39	15	1	630	69	7	0	502
10	19	2	90	40	15	0	962	70	6	2	521
11	19	1	898	41	15	0	283	71	6	1	534
12	19	1	691	42	14	2	589	72	6	0	541
13	19	1	462	43	14	1	882	73	5	2	542
14	19	1	218	44	14	1	162	74	5	1	538
15	19	0	959	45	14	0	426	75	5	0	529
16	19	0	861	46	13	0	681	76	4	2	515
17	19	0	283	47	13	1	923	77	4	1	497
18	19	0	63	48	13	1	149	78	4	0	474
19	18	2	732	49	13	0	364	79	3	2	448
20	18	2	383	50	12	2	567	80	3	1	419
21	18	2	17	51	12	1	130	81	3	0	386
22	18	1	632	52	12	0	941	82	2	2	350
23	18	1	233	53	12	0	109	83	2	0	312
24	18	0	814	54	11	2	267	84	2	2	271
25	18	0	409	55	11	1	415	85	1	1	229
26	17	2	927	56	11	0	553	86	1	1	185
27	17	2	461	57	10	2	679	87	1	0	140
28	17	1	980	58	10	1	799	88	0	2	93
29	17	1	479	59	10	0	902	89	0	1	47
30	17	0	961	60	10	0	000	90	0	0	000

The

The Order to be observed in this Table.

THe 20 Leagues which you see placed by themselves in the Front of this Table, sheweth, that 20 Leagues will make one degree of Longitude under the Equinoctiall, then the first Colume towards your left hand, manifest the degrees of Latitude beginning at one degree from the Equinoctial, and ending at 30 deg. marked in the Head with (Lat it.) importing the same thing, the three next Columes towards your right hand, sheweth the Leagues, Miles, and Paces, that answer to one degree of Longitude in any of those Latitudes, marked in the head with (Leagues, Miles, Paces) the fifth Colume beginneth the Latitude at 31 degrees, extended untill it make 60 degrees, and the three next towards your right hand shew the Leagues, Miles, and Paces, that answer to each of those degrees, and the 9th Colume taketh the Latitude again at 61 degrees, & concludeth with 90 degrees, the three next and last Columes, shew the Leagues, Miles, and Paces that answer to those degrees; as for Example, how many Leagues will make one degree of Longitude in the Latitude of 20 degrees, search for 20 degrees in the first Colume towards your left hand, then right against that Latitude in the three next Columes towards your right hand, you shall find 18 leagues, 2 Miles 385 Paces.

First, sweepe the plaine Circle of the same Magnitude, of your graduated as the figure sheweth, then draw the Diameter A B annexing at the intersection at B 350 degrees then draw as before, Diamiters from each places Longitude, as C D and R S, then as hath beene shewed before, let fall their perpendiculars from their points of Latitude intersecting their Diamiters, as F G, the signe of the *Lyzards* Latitude, and S P the signe of the River of *Plates* Latitude, then set one foote of your Compasses in the intersection of the greatest Latitude that is at F, and extend the other foote to the intersection at S, now keep still one foote at F, & turne about the other which was at S and cut the Diamiter C D at O, and then because one place hath South Latitude and the other North, you should joyne the lesse Latitude to the greater, that is to say, you should extend the signe or perpendicular F G untill it might also containe the perpendicular or signe S P, but in regard it would extend farre without the Circle, let fall a perpendicular from the intersection at O, and then transferre the signe S P from O to H which commeth all to one matter, as if they had beene joyned from G upwards, running without the Circle, and the figure is now more uniforme then it would have been with that extention, now from the poynts H G drawv the line subtending the distance, which if you take betwixt a paire of Compasses and apply to the graduated Arch, will yeeld 99 deg. 14 min. or 1985 leagues.

Fourth Question, according to the fourth Scituation.

I Demand the distance, betwixt Cape *Bonivist* in *New-fonndland* and the *Head-land*, called the *Lyzard*, both places having neerest 50 deg. of North Latitude, Cape *Bonivist* in the Longitude of 329 degrees, and the *Lyzard* in 16 degrees.

The Figure.
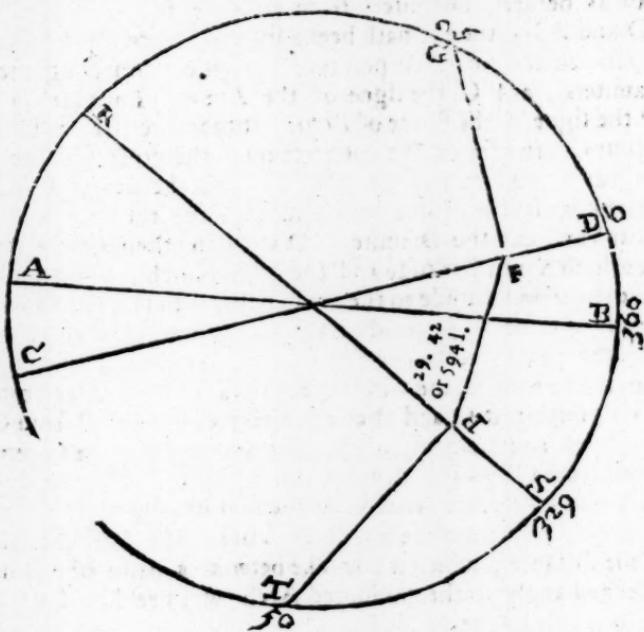
Here in this *Question*, sweep the plaine Circle of the same magnitude with your graduated, and draw the Diameter through the Center, annexing at the interfection tovvards your right hand 360, as the Figure fhevveth: and novv becaufe Cape *Boxivift* is fituated in the longitude of 329 degrees, fet one foot of your Compaffes in the interfection of the Diameter vvith your graduated Circle, vvhere 360 is annexed, then extend the other foot in the fame Circle untill it cut exactly at 329 degrees, vvhich extention transferre into the plaiue Circle, cutting the Arch dovvnvvards from the

the intersection of the Diameter, and from that cut or point, draw the Diameter R S and so in like manner transferre the point of the *Lyzards* Longitude, and draw the Diameter C D, then as hath beene formerly shewed transferre the points of both places Latitudes, and draw the perpendiculars F G and P T, which cut their Diameters at right-angles, from which intersections draw the line F P which is the subtending side or distance, and in this *Question* if you take that line betwixt your Compasses, and apply it to your graduated Circle, it will there yield you 29 deg. 42 min. which is 594 Leagues, or 1782 Miles.

These *Questions* which have beene already fully explained, both by Figure and Worke, cannot possible seeme any thing difficult to the industrious, but rather with small practice will prove most facile and delightfull in operation, all things being already so plainly demonstrated, and perfectly drawne forth for the obtaining of the true knowledge in all manner of distances, what may be the portion or part of one of the greatest Circles contained betwixt them; by which portion the true distance in any kind of measure is produced, as hath beene formerly expressed and sufficiently explained, so that it is needlesse and un-necessary to take farther paines in demonstrating the way of finding the true Distance betwixt any two places, according to the application of one of the greatest Circles, because by the former questions, if at any time there should arise any doubt in your work, you may be resolved, if according to the situation of your places Assigned, if you have relation to these former questions, and there make application according to the manner of work produced, you can neither fail nor find fault.

Now after you are able to find the true distance of any two places (each from other) that are situated upon the Terrestiall Globe, you should in the next place learne to know upon what points of the Compasse you must prosecute the Course, according to the plaine of the great Circle extended, but in regard that it requires the certaine knowledge of the quan-

titie

titie of each feverall Angle, that true portion to parts of the greateft Circle maketh with each feverall Meridian, otherways you cannot fayle the moft direct courfe, although you find the true diftance by the former Rules; the pofitions of which Angles are fo fubtill, and will feeme fo obdurate to many Sea-men, that they will not endure to take fo much paines as is required in the refolving of them, according to the doctrine of Triangles. Therefore I have devifed a more facill way for the performance of the premiffes, onely by the rules of Proportion, and the aide of my Tables here inferted; the ufe of which Tables with the rules of Reduction, and divers other reafons and obfervations; you muft be well acquainted with all before you can apply the rule of three or proportion to find out your defire; Firft then, we will begin and draw forth our Tables of Longitudes.

To account the Starres in all places to be paces, each pace containing 5¾ feet.
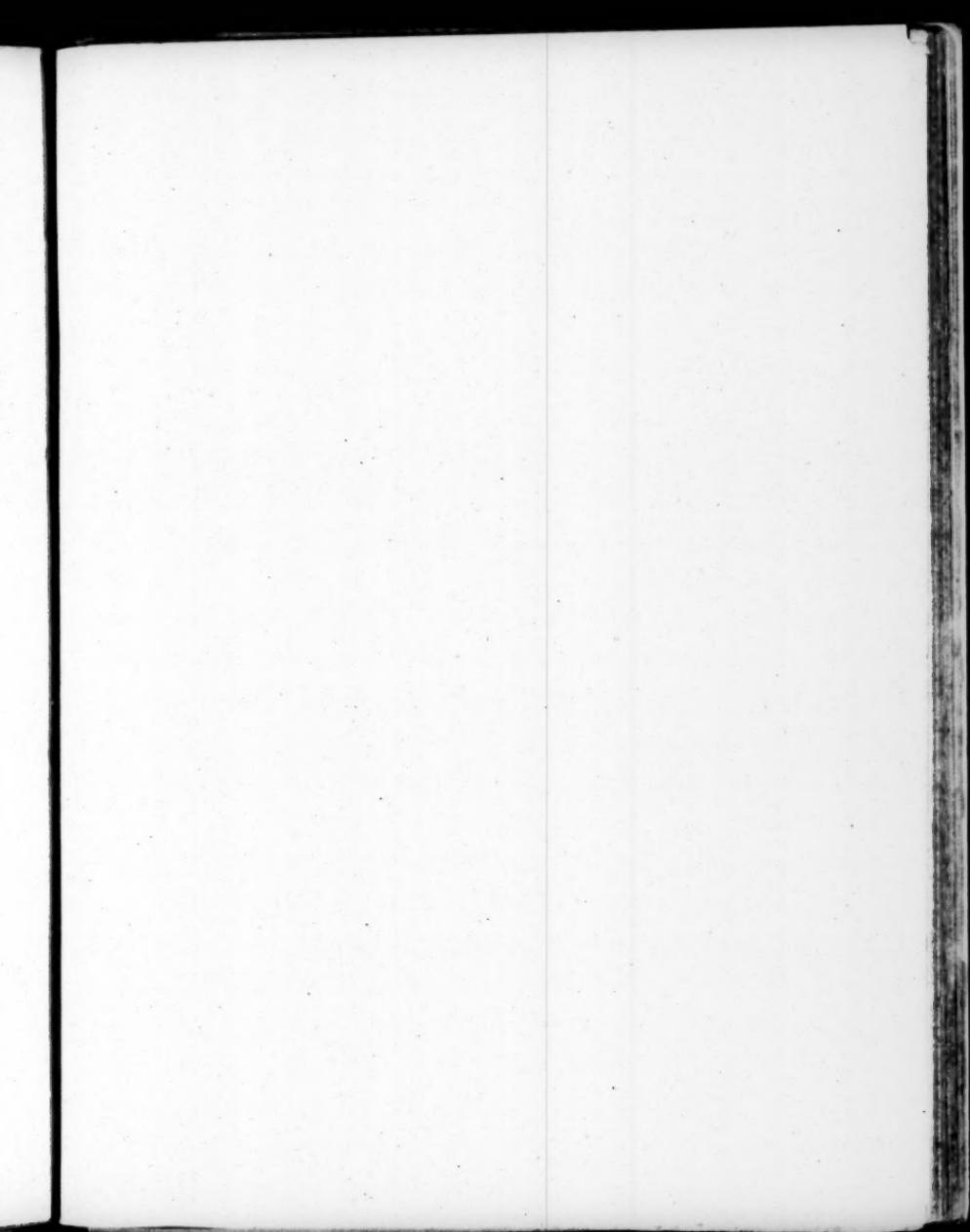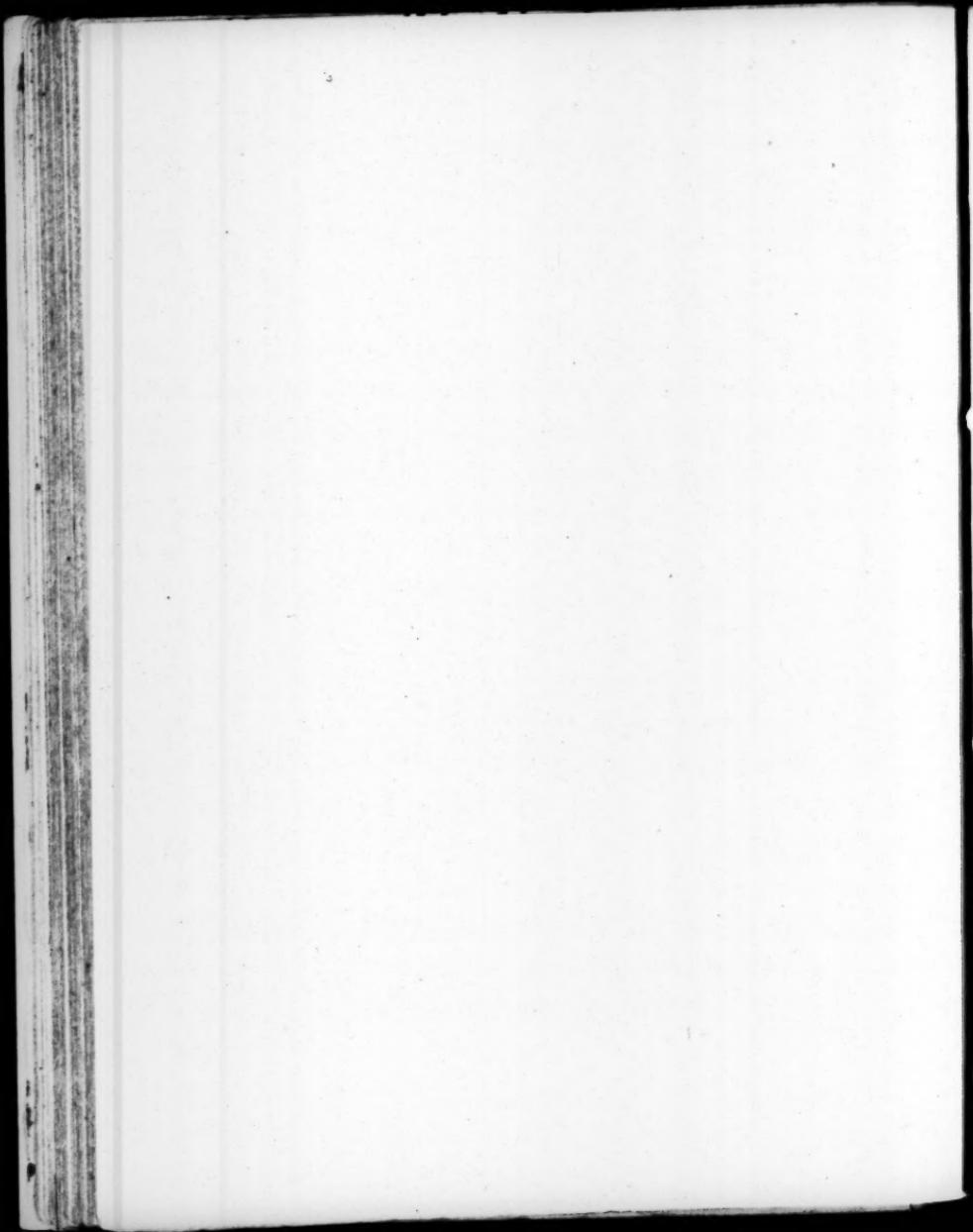
20 Leagues.											
Latit.	lea	M	Pac.	Latit.	lea	M	Pac	Latit.	lea	M	Pac.
1	0	0	6	31	2	2	569	61	10	0	911
2	0	0	36	32	3	0	114	62	10	1	832
3	0	0	78	33	3	0	678	63	10	2	760
4	0	0	144	34	3	1	258	64	11	0	769
5	0	0	228	35	3	1	848	65	11	1	643
6	0	0	329	36	3	2	457	66	11	2	597
7	0	0	447	37	4	0	81	67	12	0	557
8	0	0	583	38	4	0	719	68	12	1	524
9	0	0	735	39	4	1	370	69	12	2	498
10	0	0	910	40	4	2	38	70	13	0	479
11	0	1	102	41	4	2	717	71	13	1	466
12	0	1	309	42	5	0	411	72	13	2	459
13	0	1	538	43	5	1	118	73	14	0	458
14	0	1	782	44	5	1	838	74	14	1	462
15	0	2	41	45	5	2	574	75	14	2	471
16	0	2	319	46	6	0	319	76	15	0	485
17	0	2	617	47	6	1	78	77	15	1	503
18	0	2	937	48	6	1	851	78	15	2	526
19	1	0	268	49	6	2	636	79	16	0	552
20	1	0	615	50	7	0	433	80	16	1	581
21	1	0	983	51	7	1	870	81	16	2	614
22	1	1	368	52	7	2	59	82	17	0	650
23	1	1	769	53	7	2	881	83	17	1	688
24	1	1	186	54	8	0	783	84	17	2	729
25	1	2	591	55	8	1	585	85	18	0	771
26	2	0	73	56	8	2	447	86	18	1	815
27	2	0	539	57	9	0	321	87	18	2	860
28	2	1	20	58	9	1	201	88	19	0	907
29	2	1	521	59	9	2	98	89	19	1	904
30	2	2	39	60	10	0	000	90	00	2	000

O

THis Table hath the same order as the former, the 20 leagues placed in the Front, shewing that so many make one degree in the Equinoctial, which is a Circle of the greatest Diameter; the first Column towards the left hand, shewing the Altitude from one degree from the Line, to 30 deg. The fifth Column sheweth the Latitude again from 31 deg. to 60 deg. and the 9ᵗʰ Column from 61, untill it conclude with 90 degrees, the rest of the Columns shew the difference that is betwixt one degree of Longitude in any parallel or Latitude, if it be compared with 20 Leagues, which is a degree in the Equinoctial. As for Example, in the Latitude of 4 degrees from the Line, your Table sheweth 144 paces; which signifie, that a degree of Longitude in that parallel is lesse then 20 leagues, which is a degree in the Equinoctial by 144 paces lengths; In like manner, if you demand the difference of one degree of Longitude, in the Latitude of 45 deg. my Table will shew you 5 leagues, 2 miles, 574 paces, which explaineth, that one degree in that parallel, is so much lesse then 20 leagues, or one degree in the Equinoctial.

The Table of Longitudes which I have Calculated in single Paces, shewing how many make one Degree in any Parallel betwixt the Equinoctial and Poles.

| 60000. |

Latit.	Paces.	Latit.	Paces.	Latit.	Paces.
1	59994	31	51431	61	29089
2	59964	32	50886	62	28169
3	59922	33	50322	63	27240
4	59856	34	49742	64	26303
5	59772	35	49152	65	25357
6	59671	36	48543	66	24405
7	59553	37	47919	67	23443
8	59417	38	47281	68	22476
9	59265	39	46630	69	21502
10	59090	40	45962	70	20521
11	58898	41	45283	71	19534
12	58691	42	44589	72	18541
13	58462	43	43882	73	17542
14	58218	44	43162	74	16538
15	57959	45	42426	75	15529
16	57681	46	41681	76	14515
17	57383	47	40922	77	13497
18	57063	48	40149	78	12474
19	56732	49	39364	79	11448
20	56385	50	38576	80	10419
21	56017	51	37130	81	9386
22	55632	52	36941	82	8350
23	55233	53	36109	83	7312
24	54814	54	35267	84	6271
25	54409	55	34415	85	5229
26	53927	56	33553	86	4185
27	53461	57	32679	87	3140
28	52980	58	31799	88	2093
29	52479	59	30902	89	1047
30	51961	60	30000	90	0000

The Order observed in this Table.

THe 60000 which you see are placed in the Front, shew you
that so many paces in the Equinoctial, will make one de-
gree; then the first Column towards your left hand, sheweth
the Degrees of Latitude, beginning at one degree distant from
the Line, and extending untill it yield 30 degrees. The second
Column towards your right hand, produceth the single paces
that are contained in one degree of Longitude, in any of those
Parallels or Latitudes: The third Column beginneth the de-
grees of Latitude again, at 31 deg. and extendeth until it make
60 degrees. The fourth sheweth the single paces contained in
each of those degrees; The fifth taketh the Latitude at 61 deg.
and concludeth with 90 deg. And the sixth and last sheweth
the single paces that are contained in one degree of Longitude,
in any of those Latitudes of parallels. As for Example: If you
desire to know how many single paces in length will make one
degree of Longitude in the Latitude of 18 deg. Search in the
first Column for the Latitude of 18 degrees, and in the next to-
wards your right hand, you shall finde 57063. which are the
single paces contained in one degree of Longitude in that La-
titude: If you require how many will make one degree in the
latitude of 49, search in the third Column for that latitude, and
in the next towards your right hand, you shall finde 39364
paces, which answereth the question, &c.

The use of these Tables.

THe many uses that may be made of these Tables in the fa-
mous Art of Navigation, are not more easie then exeel-
lent, for all manner of Sea-men, which desire to have their
Conclusions crown'd with everlasting credit: For by their ayd
and assistance you shall certainly know all times, to what pa-
rallel or latitude soever that you sayl, the true proportion of
that parallel, in respect either of the Meridian or Equinoctial.

By

By which you are made able to correct the falſeneſſe of the
Charts in *plana*, which have equall degrees of latitude and
longitude in all parallels : Alſo in any courſe you may finde
your diſtance Meridional, yielding ſuch exquiſite truth that it
ſhall concur moſt exactly with the minutes of latitude, found
by your daily obſervation : The Accompt of your Ships way is
certainly known by their aid and application, let your courſe be
upon any point or points of the Compaſſe (yea al-
though you were to ſayl Eaſt or Weſt in a parallel according to
your plain Chart :) The points of your Compaſſe are found
out by their help, which you muſt ſteer upon in ſayling be-
twixt any two places : The diſtance betwixt any two places up-
on the Terreſtial Globe in reſpect of their ſeveral parallels, is
ſtraight found out in any kind of meaſure : As likewiſe, if they be
ſituated in one and the ſame Parallel or *Latitude* : alſo any
number of degrees in any parallel, by the helpe of the afore-
ſaid Tables, are inſtantly reduced into Leagues, Miles, or ſin-
gle paces : You may likewiſe as ſoon know how many ſingle
paces will make one or many degrees in all parallels : Alſo, a-
ny number of ſingle paces are immediately reduced into leagues,
Miles, or Degrees of *Longitude* according to any *Latitude* de-
ſired. The whole Circumference of the Globe in all manner of
Latitudes by their help is forth-with moſt truly meaſured ac-
cording to the Circular parallels, with infinite other excellent
concluſions, which I am certain the intelligent Sea-man will
daily diſcover, may moſt facilly be performed by their aid and
application rightly applyed and uſed, onely in the plain rules of
Proportion, commonly called the Golden Rule, or rule conſiſt-
ing of three Numbers, which no Sea-man that taketh charge of
conducting a Ship through the Sea, ſhould be ignorant of ſuch
eaſie Arithmetick. Yet I am certain, there are divers which
are not over-perfect in thoſe plain proportions ; therefore thoſe
which finde their Arithmetick will not well reach to that pitch
may perform moſt of the former Concluſions, onely with the
help of my former Tables, *Addition*, *Subtraction*, and a
little *Diviſion* rightly applyed, as the cauſe ſhall require, which

hereafter shall be manifested, by divers Questions and Examples. But for those men which are altogether ignorant in the use of all manner of Numbers wrought by the Pen, it is impossible for me to give them any instructions, whereby they may gain any good. Neither do I desire to spend my labour in fruitlesse hope, imagining I might beat brains into a Block, or turn a Copper Beaker into a gold Cup, I was never so great a Philosopher, neither do I intend to trouble my selfe with such Conclusions; therefore such feathered Fowl cannot guild their Plumes through my directions: But to the former purpose, you may understand, that these Tables which I have calculated, were drawn forth after this rate, 5 4/7 foot to make one pace, 1000 of those paces to make one mile, and 60 of those miles to make one degree in the Meridian, which punctually agreeth with Mr. *Oughtred's*, and my own opinion, that 66 Statute miles, of 5280 foot to each mile will make a true degree upon the Earth either in the Meridian, or Equinoctial, or any other great Circle extended betwixt any two places, howsoever scituated.

The Leagues which you muſt Sail upon any Courſe whole,
halfe, or quarter Point of the Compaſſe, before you ſhall
raiſe or depreſſe the Pole one Degree ; and how far
you will be diſtant from your firſt Meridian.

THere hath been very much miſtaking the matter, by divers
men, that have undertaken to diſcover the Leagues in pro-
portion, that anſwer to each ſeveral Rombe or Courſe , in rai-
ſing or depreſing the Pole one Degree ; the chief reaſon ariſing
from the diverſity of meaſures which they have made uſe of in
their Calculations ; ſome allowing five of our feet to make one
Geometrical pace , one thouſand of thoſe paces one Mile, three
of thoſe Miles one league , and 20 of thoſe leagues to make one
Degree , in the Equinoctial or Meridian ; then which there is
nothing more falſe , for it will not yield the meaſure , accord-
ing to the reall truth that is contained in 20 leagues, when it
muſt anſwer the proportion of one Degree in the Meridian ; o-
thers again, doth allow 1700 hundred Engliſh yards to make
one mile , three of thoſe miles to yield one league , and 20 of
thoſe leagues to one Degree of the Meridian ; which is likewiſe
contrary to the true proportion. Our Engliſh Navigators plead
Statute meaſure, that is, 3 Barley-corns to make one Inch , 12
Inches one foot, $16\frac{1}{2}$ foot one pearch, 40 pearches one Furlongs
8 Furlongs , or 320 pearches, which is 5280 foot to be one
mile, and 60 of thoſe miles to make one Degree in the Meridi-
an. Mr. *Norwood* by his experiment made in *England* , ſaith,
6000 foot is one mile, and that 60 of thoſe miles makes one de-
gree in the Meridian , to which proportion the *Spaniſh* ac-
compt concurreth within a ſmall matter; amongſt theſe diverſities
of opinions, I ſuppoſe the practical Sea-man doth not yet ap-
prehend or make uſe of the true quantity belonging to one De-
gree in the Meridian : For Mr. *Norwood* and the *Spaniſh* ac-
compt would have them allow but 68 of our Statute miles to
make one Degree, which truly I have found by many practi-
call obſervations, and preciſe calculations , may be ſome-thing
too

too great a proportion ; Yet our Degree according to Statute-
meafure is much more too little. Therefore I fhall now joyne
my Judgement with learned *Oughtred*'s opinion in this matter,
which I fuppofe will be the beft mean proportion amongft fo
many feveral opinions , who faith that 66 of our Eng-
lifh Statute miles , after the rate of 5280 Englifh feet to each
mile will make one true Degree in the *Meridian*, which I con-
clude is the very beft and neereft rate of all others, and accord-
ing to that proportion have now calculated all my Tables, al-
lowing 1000 paces of 5⅘ foot to make one mile, and 60 of thofe
miles to make one Degree in the *Meridian* ; So that now one
of thefe miles will contain 5808 feet, and 60 of thofe miles will
make one Degree in the *Meridian*, which anfwereth directly
to 66 miles of our Statute miles after 5280 feet to each mile,
which *Oughtred* faith is one true Degree in the *Meridian*, &c.
Now if I may prevail with our practical Englifh Sea-men , I
fhall advife them all to mark their Log-lines directly according
to this proportion , which is moft eafily done onely by adding
one Fathom more to each knot : For whereas heretofore they
allowed 7 Fathom to be one Knot, which is 42 feet , I would
have them to allow 8 Fathom to be one Knot , which is 48
feet , and then to account all things by a halfe minute glafs, as
before, without any manner of alteration : And be fure you fhall
make the beft dead reckonings that ever you made at Sea ; For
indeed 7 Fathom or 42 feet to a Knot is no proportion to make
out a degree according to 60 miles , neither can heaving the
Log upon that account do you any good at all.

A Table

Course.	Leag.	Mile.	Pac.
North.	20	0	000
1/4	20	0	072
1/2	20	0	291
3/4	20	0	654
N. by West.	20	1	173
1/4	20	1	854
1/2	20	2	697
3/4	21	0	723
N.N.West.	21	1	941
1/4	22	0	375
1/2	22	2	037
3/4	23	0	948
N.W.by W	24	0	159
1/4	24	2	703
1/2	25	2	625
3/4	26	2	970
North-west.	28	0	852
1/4	28	2	349
1/2	31	1	560
3/4	33	1	710
N.W.by W	35	2	997
1/4	38	2	721
1/2	42	1	245
3/4	46	2	310
W.N.West.	52	0	786
1/4	59	1	134
1/2	68	2	595
3/4	82	0	861
W.by North	102	1	548
1/4	236	1	113
1/2	103	1	935
3/4	406	2	991
West.	000	0	000

Course.	Leag.	Mile.	Pace
North.	0	0	000
1/4	0	2	949
1/2	1	2	916
3/4	2	2	895
N. by West.	3	2	934
1/4	5	0	033
1/2	6	0	109
3/4	7	0	402
N.N.West.	8	0	852
1/4	9	1	383
1/2	10	2	079
3/4	11	2	955
N.W.by W.	13	1	089
1/4	14	2	565
1/2	16	1	254
3/4	18	0	372
North-west.	20	0	000
1/4	22	0	207
1/2	24	1	086
3/4	26	2	886
N.W. by W.	29	2	796
1/4	33	1	119
1/2	37	1	212
3/4	42	0	834
W.N.West.	48	0	852
1/4	55	2	727
1/2	65	2	688
3/4	79	2	457
W.by North.	101	2	838
1/4	134	2	688
1/2	202	2	280
3/4	406	1	518
West.	000	0	000

A Table shewing how many Leagues, Miles, and Paces you must saile upon any point of the Compasse, before you can raise the Pole one degree, and how farre you will be then departed from your first Meridian.

Certain Rules of Reduction , performed by the aid of my former Tables, and a little Arithmetick rightly applyed.

AFter you have taken heedful obſervation of my former Tables which I have carefully calculated, it followeth moſt fitly, that you ſhould endeavour to acquaint your ſelfe with all manner of Rules of Reduction, whereby you will be able upon all occaſions (with the help of my former Tables) moſt readily to reduce any kinde of meaſure into what other Denomination you deſire, as by theſe following queſtions is plainly expreſſed.

A Rule how to reduce any number of Paces into Leagues.

WHen you have any certain number of Paces that you would reduce or turne into Leagues : Firſt, ſet down the given number, then cut off three of the laſt figures towards your right hand, which figures ſo cut or ſeparated from the reſt, doth at all times ſhew you the odde paces that will happen, becauſe they can never at no time yield either Mile or League ; then take the reſidue of the Figures which remain towards your left hand, and divide them by 3, and the quotient will yield you the Leagues deſired ; if any thing remain upon the Diviſion, they are ever Miles, and your remainder will never exceed 2. As for Example.

First Question of Reduction.

I Demand, what number of Leagues will be contained in the ſumme of 6974895 paces.

Manner

	r2		lea.	mi.	paces.
Manner of worke.	6974	895	2324 —	2 —	895
	3393				

Here in this question according to the manner of worke
which you see performed, you may observe that 895 were first
cut off with a down-right dash of the Penne, from the given
Number, which sheweth the odd paces as before; then the resi-
due of the Figures towards the left hand, namely, 6974 being
divided by 3. the quotient doth yield 2324 Leagues, and 2
remaining upon the Division, which sheweth that two odd
miles happen upon this question; and so you cannot but plainly
perceive, that 2324 leagues, two miles, 895 paces, answereth
the former demand.

A Rule how to reduce any Number of Paces into Degrees of Longitude, according to any Parallel.

WHen you have any Number of paces given, that you
would turne into degrees of Longitude, according to
any Parallel or Latitude that you desire: First, set down the
number of paces, then search in my Table of *Longitudes*, cal-
culated in single paces, how many will make a degree in that
Parallel, which must be your Divisor to divide the summe gi-
ven, and the quotient will shew you the degrees desired; if
any thing remain upon the Division, they are ever the odd pa-
ces, which will not amount to make a Degree: therefore you
may reduce them most readily into Leagues and Miles, as I
shewed you before.

Second question of Reduction.

I Demand, how many Degrees of Longitude, 745948 sin-
gle Paces will yield in the Parallel of Latitude of 25 degrees,
00 minutes.

P 2　　　　　　　　　Here

Here in this queſtion, you muſt firſt ſet downe 745948. the number of the paces given, then ſearch in my Table of *Longitudes* calculated in ſingle paces, how many will make one degree in the *Latitude* of 25 deg. 00 min. and you ſhaall finde 54409, with which ſumme, if you divide 745948. there cometh into the quotient 13, which are the degrees of *Longitude* deſired, and there remaineth upon the Diviſion 38631. which are ſingle paces, that will not make one degree of *Longitude* in the afore-ſaid *Latitude :* therefore you may reduce them into Leagues, Miles, and Paces, as I have ſhewed before ; and they will yield you 12 leagues, 2 miles, 631 paces ; As for Example.

	38				
Manner of worke.	59|63		le.	m.	paces.
	20185|1		12.	2	631
	745948			2	
	544089		38|631|12		
	5440		33|		

A Rule to reduce the Degrees of Longitude, in any Parallel or Latitude, into ſingle Paces.

Firſt, ſet down the Degrees which you would reduce into paces; then ſearch in my Table of *Longitudes*, in ſingle paces, how many anſwer to one Degree of *Longitude* in that *Latitude* which you deſire : multiply that ſum by the Degrees, and you have the Paces. As for Example.

Third Queſtion of Reduction.

Demand, how many ſingle paces are contained in 19 Deg. of *Longitude*, in the Parallel or *Latitude* of 50 degrees.

Manner

$$
\begin{array}{r}
58567 \\
19 \\
\hline
347103 \\
38567 \\
\hline
732773
\end{array}
$$

Manner of worke. ——

Here in this queſtion you may perceive by the manner of worke, that 38567 are the ſingle paces which make one degree of *Longitude* in the Parallel or *Latitude* of fifty degrees, which paces being multiplyed by 19 degrees, will yield 732773 which are the ſingle paces contained in 19 Degrees of *Longitude* in the *Latitude* of 50 Degrees, which anſwereth the queſtion.

A Rule to reduce any number of Leagues into ſingle Paces.

WHen you would reduce or turne any certain number of leagues into ſingle paces : Firſt, ſet down the number of leagues given, then cut off with a daſh of your Pen, the three Figures which are next towards your right hand, & multiply the reſidue which remain towards your left hand by 3, to the Off-com or Product, adjoyn thoſe three Figures which you did formerly cut or ſeparate from the reſt, and that totall Areare, is the paces deſired. As for Example.

Fourth

Fourth question of Reduction.

I Demand how many single paces are contained in 975 Leagues?

$$
\begin{array}{r|l}
 & 975 \\
 & \underline{3} \\
\textit{Manner of worke} & 19253\,000
\end{array}
$$

A Rule to reduce or turne the whole Circumference of the Terrestiall Globe, according to any Parallel or Latitude, into Leagues, Miles, or single Paces.

WHen you would reduce the whole Circumference of the Globe into any meafure that you defire ; First , obferve the Parallel or Latitude , wherein you defire to know the quantity of Leagues , Miles, or Paces, that fhould furround the whole body , and then fearch in my Table of *Longitudes*, calculated in fingle paces , how many will yield one degree in that Parallel ; which fum if you multiply by 36, and to the Officom adjoyn one Cypher , that totall arrear fheweth the fingle paces contained in the whole Circumference of that Parallel ; which you can reduce into Leagues and Miles as I nave formerly fhewed you , which will appear moft plainly by the following Example.

Fifth question of Reduction.

I Demand, how many leagues is contained in the whole Circumference of the Terreftial Globe, according to the Circular Parallel, in the Latitude of 50 Degrees.

$$
\begin{array}{r|l}
 & 38576 \\
 & \underline{36} \\
 & 231456 \\
 & 115728 \\
\textit{Manner of worke} & 1388736\circ
\end{array}
$$

$$ 2 \times \circ $$

$$
\begin{array}{c|c}
12 & \text{Lea. Mil. Paces.} \\
13887\,360 & 4629. \ 0. \quad 360 \\
3333 &
\end{array}
$$

Here

Here in this Question, you may perceive by the manner of worke, that 38576 single paces yieldeth one Degree of *Longitude*, in the *Latitude* of 50 Degrees, which paces being multiplied by 36, and to the Off-come adjoyning one Cypher, the total product amounteth to 13887360, which are the single paces that will surround or compasse the whole Globe in that Parallel of 50 Degrees. Which paces you may see, being reduced into leagues, doth yield 4629 leagues, 0 min. 360 paces, which are the leagues and paces contained in that whole Circumference, and answereth the question in those sorts of measure.

If you would know the Miles and Paces that will answer to this whole Circumference of the Globe, onely take the former totall Arear, and cut off with a down-right dash of your Pen, the three Figures towards your right hand, and you have your desire; for the three Figures cut off from the rest are ever the single paces, and the residue remaining towards your left hand, are the Miles. As for Example, 1 mile, 36 paces, 13887336o.

A Rule to finde the *Diameter* of any Parallel, having the whole Circumference first given, either in Leagues, Miles, or single Paces.

WHen you would finde the Diameter of any Circular Parallel that is described upon the Terrestial Globe, after you have observed the latitude or breadth, and how it is scituated, in respect either of the Pole or Equinoctial; Then take this course, Multiply the whole Circumference by 7, and divide that product by 22. the quotient will answer your desire. As for Example; we will of purpose take in hand to finde the Diameter to the Parallel of 50 degrees, which was our sixth and last fore-going question of *Reduction*, because after we have found that Diameter, by the same Diameter we will finde again the Circumference, and so shall need no farther illustrating the matter, in regard if you judiciously observe the concurring of the two Circumferences severally found out, it will satisfie you for the surenesse and sufficiency of the

worke,

worke in all other Parallels, being ever performed by the same manner, as is already mentioned.

A Question of finding the Diameter of any Parallel Circle.

I Demand, how many single paces is contained in the Diameter of the Circular Parallel, scituated in the Latitude of 50 degrees from the Equinoctial.

Here in this Question, you must first turne the whole Circumference of the Parallel in the Latitude of 50 deg. all into single paces, as hath been formerly shewed, and it will amount to 13887360, which summe you must multiply by 7. and the product is 97211520, which divide by 22. the quotient is 4418705, and 10 remaining upon the division, which is a Fraction of one pace : The question being answered in single paces, which if reduced into Leagues, yieldeth 1472 leag.——2. Mil. ——705 paces, $\frac{10}{22}$ the true length of the Diameter desired.

How to finde the whole Circumference of any Circular Parallel by the Diameter.

I Demand, the whole Circumference of the Parallel Circle in the Latitude of 50 deg. the Diameter being found as before to be 1472. leagues, 2. miles, 705 paces $\frac{10}{22}$.

Here first, reduce 1472 leagues,–- 2 miles, -- 705 paces, the length of the Diameter into single paces, it maketh 4418705 which summe now multiply by 22. and it yieldeth 97211510. to this totall product adjoyn 10. the Numerator of the Fraction, and then it maketh 97211520. divide this summe by 7. the quotient sheweth 13887360. which is the whole circumference of the Circular Parallel, at the Latitude of 50 degrees, the thing desired ; and being reduced into Leagues, maketh 4629 lea. ——0 mil. -—- 360 paces, agreeing with the former rule of Reduction.

A Reason of the Work.

THe Reason why this work is thus drawn forth in searching for the true Diameter of any Circle, is in respect, that all manner of Circumferences are more then triple the Diameters, by a certain fragment or small part, which in the neerest calculation that I could ever find out, was more then $\frac{10}{71}$ of the same: Now take the neerest rationall Proportion, and you will find that it as is 22 is to 7 in my Judgement not possible to be drawne neerer.

These Rules of Reduction, which are formerly explained, being well observed by the judicious Practitioner, I am certain, will yield him such satisfaction in the facile performance of divers matters, which heretofore were most obdurate and doubtfull with the utmost of his endeavors to find out, that he cannot but yield some gratefull acknowledgment to the Author of this work, as the Instrument of ease to many of his conclusions.

How to find all manner of Meridionall distances, according to the Courses which you are to saile, in proportion as they are described upon the Globe.

AFter you have sufficiently enformed your selfe with the wayes of reduction, it is very proper that you should in the next place apply your selfe to find out, how farre you shall be separated from your first Meridian, in sayling upon any course, according to the truth discovered by the Globe: For I am most certaine, that the disproportion which hath hitherunto beene commonly used amongst Sea-men, in drawing forth their Meridional distance, (according to the plaine Chart,) hoping that it would meete or concurre with their Latitude found by observation, hath beene the chiefe cause of such grosse mistaking the matter, that many times they have had their expectations deceived 2 or 3 hundred Leagues in sayling not above 14 or 15 hundred: For in respect all the Lineaments had parts of the plaine Chart, which hath in all Parallels, equall degrees of Latitude and Longitude, are in

Q   generall

generall so grossely false, you must ever expect such preposterous
conclusions ingendred by his directions, in the prosecution of
long Voyages; wherefore, if you please with patience, first,
to allow the truth of the premisses, I will then give you dire-
ctions by the help of my former Tables, how you shall find the
true Meridionall distance according to the Globe, upon what
Course soever you shall Sayle; or in respect of the distance
betwixt any two places howsoever Scituated, which I will ma-
nifest and make plaine unto you, by resolving of these following
Questions, desiring that you would ever have a speciall regard
to your Meridionall distance as the maine point in Navigation,
that will not faile to produce the certaine truth, if with judge-
ment you draw your point of Longitude, most exactly to con-
curre with your daily observation of the Latitude.

THere are two places to the North-wards of the Equinoctial
one Scituated in the Latitude of 60 deg. the other in the
Latitude of 40 deg and they differ 20 degrees of Longitude in
the Equinoctial, according to the intersection of their severall
Meridians. Now I demand, if you were to saile betwixt the
afore-said places, by the most direct course that was possible to
be found out, how many Leagues you would allow the Ship to
be separated from your first Meridian, according to the Globe.

Here in this question, first, turne the 20 degrees of Lon-
gitude distant in the Equinoctial into Leagues, and they vvill
yield you 400 then take 20 degrees, in the Parallel or Lati-
tude of 40 deg. and turne those degrees into single Paces, as
formerly I have shewed, and they will yield 919240 then
turne 20 deg. of Longitude in the Parallel of 60 degrees into
single Paces, and there will arise 600000 which two summes
containing the single Paces according to each Parallel, ad-
joyne into one summe, and then it will yield 1519240. Now
the halfe of this totall sheweth the Meridional distance in
                                                        single

single Paces, that is contained betwixt the afore-said places according to the proportion of the Globe, which if you turne into Leagues by reduction, will yield 253 leag. ——— 0 min. ——— 620 Paces, as appeareth by this Example.

Manner of Work.

Single Paces contained in the Parallel of 4 d. —— 919240
Single Paces contained in the Parallel of 60 ——600000
Both summes adjoyned into one, will make —— 1519240
The halfe summe in single Paces or distance Meridionall desired. ——————————— } 759620

You may observe by this Meridional question, what Errour in your Longitude the plain Chart would have lead you into, if according to his directious you should have drawne forth your meridionall distance : For that instrument having in all Parallels or Latitude, equall degrees of Latitude and Longitude, must of necessity have yielded you the distance Meridional, according to the degrees of the Equinoctial, which sheweth 400 leagues, then which you see most apparently nothing can be more contrary to the truth of the Globe, therefore the intelligent Artist will not endure to follow such directions, for whose sake I have taken thus much paines to prescribe these new Rules, rendring (if rightly used) upon all occasions the most infallable truth.

Second Meridional Question.

I Demand, if you should sayle 12 degrees West, in the Latitude of 80 degrees, and then was enforced to Steare due South, untill you come into the Latitude of 0 degrees, how many Leagues you would be then distant from your first Meridian.

Here in this question you have no more to doe but onely to turne 12 degrees in the Parallel of 80 into single Paces, and it will yield 125028 which summe if you reduce into

Q 2   Leagues,

Leagues, doth make 41 lea. -— 2 mil. ---- 28 Paces. And now in regard it is suppofed, that you are in the Parallel of 50 deg. having kept the former Courfe, turne 12 deg. of that Parallel into single Paces, and it will yield 462912 which if you reduce into Leagues, doth yield 154 lea. ---•- 0 mil. -- --- 912 Paces, which anfwereth the queftion, and in the true diftance Meridionall in that Parallel, according to the Globe.

Third Meridional queftion.

I Demand, in the Latitude of 40 Degrees, how many Leagues one degree of that Parallel is leffe, then one degrees of the Equinoctiall.

Here in this queftion, you muft turne to my Table containing the Difference of Longitude, and there feeke the Latitude of 40 degrees and the three next Columes towards your right hand, will fhew 4 Leagues, 2 miles, and 38 Paces which anfwereth the queftion; for fo much is one degree of Longitude in that Parallel leffe, then one degree of the Equinoctial.

Fourth Meridional queftion.

THere are two places in the Parallel or Latitude of 60 deg. and by the Equinoctial are Diftant each from other 20 deg. or 400 Leagues: Now I demand, how many degrees and Leagues the afore-faid places are diftant from each other, according to their Parallel in 60 deg.

Here in this queftion, fearch firft in my Table calculated in fingle Paces, how many anfwer to one degree of Longitude in the Latitude of 60 degr. and you will find 30000 which Paces, multiply by 20 the deg. in the Equinoctial, and they will yield 600000 which anfwereth the queftion in fingle Paces and being reduced into Degrees and Leagues, as I have formerly fhewed you, will produce 20 deg. of that Parallel, or 200 Leagues the proportion defired.

Fifth Meridional question.

THere are two places, one lying in the Latitude of 40 degrees the other in the Latitude of 60 deg. and are diſtant 15 deg. of Longitude, by the degrees in the Equinoctial.

I demand how many Leagues are contained betwixt the Meridians of thoſe two places, according to their ſeveral Parallels.

Turne one degree in each Parallel into ſingle Paces, and then multiply their products by 15 the deg. of the Equinoctial, and you have the ſingle Paces contained in each Parallel, which you know how to reduce into Leagues, and in this queſtion, the Parallel of 60 deg. will yield you 150 lea. and the Parallel of 40 deg. will yield 229 lea. ----- 2 mil. ----430 Paces which are the true diſtances in each places Parallel, according to the proportion of the Globe.

There are infinite other queſtions which you may daily performe by the helpe of my former Tables, with ſo much eaſe that you cannot allow the uſe of the plain Chart, (to exceed them in that point) yet I am certaine you cannot now chooſe, but perceive how farre the Concluſions wrought by the former Directions doth excell the plain Chart, which you ſee apparently hath need of Crutches, being lame in all his Lineaments.

How to finde the Courſe or Point of the Compaſſe, when you are to Saile in any Parallel, according to the Diſtance taken by the Arch of one of the greateſt Circles.

HAving throughly acquainted your ſelves with the true uſe of my former Tables, the rules of Reduction, the true quantity of Leagues, Miles, and Paces, which you

you muſt Sayle upon all Courſes , before you raiſe or depreſſe
the Pole one degree ; as likewiſe how much you ſhall varie in
each degree from your firſt Meridian , and all the matters in
generall formerly explained , then if your Courſe be according
to any Parallel , you may proceed to find out the Points of the
Compaſſe by which you muſt ſteere according to the plaine of
the great Circle extended , betwixt any two places ſo Scituated ,
but if the two places differ much in Latitude as well as in Longi-
tude, then it is moſt vaine to endeavour to proſecute your courſe
by the Compaſſe according to the plain of that Circle exten-
ded, as ſhall be at large explained, where I will ſhew you how to
order your affaires according to ſuch manner of Courſes, if they
differ but a ſmall matter in Latitude, then your Parallel dire-
ction ſerveth.

A Parallel Queſtion.

I Demand , the Courſe and Diſtance according to the Arch
of one of the greateſt Circles extended , betwixt the Iſland
called by the name of *Shotland* , being one of the Iſles of *Ork-
ney* , which is Scituated in the Latitude of 60 degrees to the
North-ward of the Equinoctial , and hath 21 degrees of Lon-
gitude , and the great Iſland called *Deſolation* , which lyeth in
the way as yon ſayle to *Danes* Straights , and is alſo Scituated
in the Latitude of 60 degrees of North Latit. and hath 330 deg.
of Longitude.

To proſecute your Courſe in this queſtion , and other of
like Nature , according to the poſition of each ſeverall Angle,
that the Great Circle extended betwixt the afore-ſaid places
produceth , I know will prove ſo trouble-ſome , that the Mari-
ner, I am certaine will not endure ſuch directions , and al-
though he ſhould take ſuch paines , the profit ariſing will be
but a poore reward , in regard the Ship will not nor cannot be
conſtrained to obſerve them in her Courſe through the Sea :
whe re-

wherefore leaving such nice Conclusions, to the Practitioners in quiet studies on the Land, I will shevv the Mariner a facile way how hee shall find out a Course or point of the Compasse according to the distance discovered by the plaine of the Great Circle extended, and yet in the whole Course shall not alter the point of the Compasse above thrice, which he may very easily constraine the Ship to performe, as shall be now explained according to the question propounded.

First then, to resolve the question, you must find the true Distance betwixt the Isle of *Shotland*, and the Island called *Desolation*, according to the Arch of a great Circle, as hath bin shewed heretofore; which will appeare by work, is 4ʒ6½ leagues; Now turne halfe the distance of degrees that is contained betwixt the afore-said places into Leagues, as hath likewise been formerly shewed, and there will arise 510, from which if you subtract 4ʒ6½ the distance by the great Circle there remaineth 13 halfe leagues, which sheweth that you will make your way so much shorter, then if you should sayle by your East and West Parallel. Now then turne the Leagues found by the extention of the Great Circle into single Paces, and it will yield 1489500 then reduce the 510 leagues, the Distance in the Parallel, and it yieldeth 1530000 single Paces. Novv suppose you were beginning to shape your Course from the Island of *Shotland*, to sayle to the former Island called *Desolation*; you may in the first place very plainly perceive, that if you should sayle any thing to the South-ward of your Parallel, you must needs make your way longer, in regard all Parallels betwixt your Latitude of 60 degrees, aud the Equinoctial retaine a bigger proportion in respect of the Meridian; but all Parallels, contained betwixt your Latitude aud the Pole yield a lesse proportion, therefore you may conclude according to reason, that you must ever shape your Course to the North-ward of your parallel if you intend to sayle according to the plaine of the great Circle extended: Now then being assured, you are to sayle to the North-ward

ward of your Paralell, you muſt find in this manner the great-
eſt point of North Latitude that you are to touch; at firſt,
turne all the Degrees of the Meridian which are contained be-
twixt your Latitude of 60 degrees, and the Equinoctial into
ſingle Minutes, which you may eaſily performe at all times,
if you multiply the degrees of Latitude by 60, the product
yieldeth your deſire: As in this Example, 60 degrees of La-
titude multiplied by 60 will yield you 3600 which are the ſin-
gle Minuts deſired: Now apply the backe rule of proportion
in this manner, ſaying, if 1530000 the ſingle Paces contain-
ed in the diſtance by the Paralell, yield 3600 minutes of the
Meridian, what ſhall 1489500 ſingle Paces, the diſtance by
the Arch yield, which if you worke according to the re-
verſed Rule of proportion, will produce 3697 Minutes of
the Meridian, which minutes if you divide by 60 the quo-
tient ſheweth 61 degrees and 37 remaining upon the diviſion
which are minutes, Therefore you may now conclude, that
the point of your greateſt North Latitude which you muſt
touch at in this queſtion, is 61 degrees 37 minutes. Now to
find the points of the Compaſſe which you muſt direct your
Courſe by, according to the plaine of the great Circle exten-
ded; Firſt, divide 1489500 the ſingle Paces in the Diſtance
by the great Arch into three equall parts, which doth repre-
ſent the three ſeverall points of the Compaſſe, by which you
are to ſaile, and in this queſtion you will find the one third
part is 496500 Paces then take the odde degrees and
minutes of Latitude, which exceed your Parallel of 60 degr.
namely 1 degree 37 minutes and turn them into minutes, and
they will yeeld you 97. Now apply the plain rule of pro-
portion, ſaying, if 97 minutes of the Meridian yield
496500 ſingle Paces upon the Courſe, what ſhall 60 Mi-
nutes, being one degree of the Meridian yield, and the
worke will ſhew you 307164 Paces, which if you reduce in-
to leagues, amount to 102 leagues, one mile, and 64 Paces,
which are the Leagues and Paces which you muſt ſayle upon,
the Courſe before you ſhall raiſe the Pole one Degree: Now
                                                              then

then, if you repaire to my table which sheweth the Leagues, miles, and Paces, which you must sayl upon any point of the Compasse to raise the Pole one degree, and there make application, searching out what point will come the nearest in his proportion to 102 leagues, 1 mile, 164 Paces you will find it is West, and by North, upon which course you must Sayle 496500 Paces, which will raise the Pole, 1 deg. 37 min. and touched the parallel according to the point of your greatest Latitude formerly found, concluding one point of the Compasse by which you are to sayle, and yielding you the one third part of your distance to be expired, Now you must sayle 496500 Paces, which is one other third part of the distance due West, keeping your selfe exactly in that parallel of 61 deg. 37 min. untill that third part be also expired, then in regard your first course was W. by N. you must sayle 496500 Paces West by South untill you find by your observation that you are come againe into your first parallel or Latitude of 60 degrees, and then is this third part which is the last of the three also expired, and now you may be most confident that your Ship is close aboard the great Island called *Desolation*, which is the place you were to sayle unto, and you have made your course shorter by 13 ½ leagues then it would have been, if you had sayled according to the direction of your East and West parallel, besides the great ease and helpe which you have according to this kind of sayling, to accompt your Ships way through the Sea by your daily observations, in regard it plainly appeareth, that you shall raise and depresse the Pole upon this whole course neare upon 5 degrees of Latitude, I know the ingenious Artist will quickly discerne there is sufficient reason to satisfie (it is worth his labour) to prosecute his parallel course, according to these plaine and easie directions, which cannot in any kind seeme obscure or darke to his understanding, unlesse perchance he should not be over-well acquainted with *Regula reversa*, or the backe Rule of Three, which indeed is a most excellent Rule, both to resolve divers questions of Navigation, as also to produce the infallible truth in divers o-

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ther practices: Therefore, and because I am most certaine, that very many Sea-men, take little notice of so necessary a Rule, I will briefly shew you the reason of the proportion, (for want of which understanding I doubt many of you have omitted the manner of Worke.) First then, you must take notice that in the plaine Rule of proportion (or Three) the first number and the last beare a plain proportion, in respect of each other, that is to say, if the first number be biggest it yieldeth the greatest proportion: if least, then the least proportion; As for Example, (if 9 give 6 then 3 will yield 2) or (if 3 give 2 then 9 will yield 6) But in *Regula reversa* the proportion doth not so answer, for if you say by that Rule (if 9 give 6 then what shall 3 it will yield you 18) or if 3 give 18 what shall 9 it will yield you 6) I will explaine the matter and manner of worke by this easie Question.

A Question of the reversed Rule of Three.

I Demand, if 9 men in 6 dayes will compleatly rigge a certain Pinnace, in what time shall 3 men rigge the afore-said Pinnace.

Now if you should apply the plain Rule of three, and say if 9 men require 6 dayes, what shall 3 men require, it will yield you two dayes which is a matter contrary to all manner of Reason, that three men should rigge the Pinnace in lesse time then 9 men, therefore you may perceive the plain Rule of Three is not capable to resolve this Question, but if you apply the reversed Rule, saying, if 9 men require 6 dayes to rigge the afore-said Pinnace, what time shall 3 men require, and it will yield you 18 dayes, which is the truth desired.

Manner of work.

IF 9 men require 6 dayes, what shall 3 men require ?

$$\begin{array}{c} 6 \\ \hline 54 \end{array}$$

$$\begin{array}{cc} 3 \\ 54 & \underline{|18 \text{ dayes.}} \\ 33 \end{array}$$

Here you see, by the manner of work used in the versed Rule, that 9 the first number being multiplyed by 6 the second number doth yield 54 which being divided by 3 the last number, the Quotient giveth 18 which are dayes, and answereth the question. Knowing the excellent Conclusions performed by this Rule, I could not but give the Sea-men this little taste, which I am certaine hath the true relish, and perchance may stirre up their appetites with a longing desire, freely to feast on such faire and pleasant fruits.

The Order to be observed in your Sailing betwixt any two places that are Scituated in severall Latitudes and Longitudes.

WHen you are to sayle betwixt any two places assigned, that differ both in Latitude and Longitude, after you have found the true distance according to the Arch of a great Circle extended, you must not imagine to prosecute your course according to the position of each severall Angle, that the Ship must be constrained to performe, if you should sayle by the plain of that great Circle so extended, for first, you will gaine so small a matter in the shortning of your way, that it will not be worth looking after. And then must be enforced to steere (point blanke) as I may tearme it, with your place assigned, concluding your Latitude and Longitude in one minute, which we all know (that have experience at Sea) is not the best course to be observed, for if we should misse the least matter either in observation, or accompting our Meridional distance. In sayling to

alone

alone Island in the Ocean Sea, we might quickly with our over-nice Conclusions, shoot beyond the Marke, which would redound more to our discredit, then the profit of so prosecuting our course, would ever promise us.

Therefore, when you are to sayle according to such distances: first, find out the true quantity of Leagues, according to the great Arch extended, which Leagues turne into single Paces, then consider the Latitude of both places, subtracting the lesser from the greater; if both places, be situated either to the North-ward, or South-ward of the Equinoctiall, and the remainder will shew you, how many Degrees and Minutes, you must raise or depresse the Pole in your whole course. But if one of your places should lye the South-wards off the Line, and the other to the North-wards, then adde the lesser Latitude to the greater, and the Off-com or totall summe, sheweth how many Degrees and Minutes you will raise or depresse the pole, upon that whole course, which Degrees and Minutes so found out, turne all into single Minutes, then take the Minutes contained in one degree of the Meridian, which are ever 60 with which summe, multiply the single paces contained in the distance found, by the great Arch, and then take the Product, and divide it by the single Minutes contained in the difference of your Latitude, and the Quotient shew you how many paces you must sayle, before the pole shall be raised or depressed one degree: which paces, if you reduce into leagues, and then compare those leagues with the leagues answering in my former Table, to each point of the Compasse, in raysing the pole one Deg. you will finde the point of the Compasse by which you are to sayle, as shall appeare by this Example.

Question.

I Demand, the Distance and Course by the point of the Compasse that you must steere upon, in sayling betwixt the
Head-

Head-land in the West of *England* called the *Lyzard*, lying in 50 degrees of North Latitude, and in 16 degrees of Longitude, and the Island called the *Barbadoes* in the West-Indies, being scituated in 13 deg. of North Latitude, and in the Longitude of 313 deg.

Here in this question, first finde out the distance by the great Arch, which will appeare to be 1257. Leagues, and being turned into Paces, doth yield 3771000 then subtract 13 deg. the lesser Latitude, from 50 deg. the greater, there remaineth 37 degrees, which turned into single minutes, will yield 2220. Now if you take 60 minutes; which make one degree of the Meridian, and multiply 3771000 the Paces contained in the distance by the Great Arch, the product will amount to 226260000 Paces, which Paces, if you divide by 2220 the minutes that arise in 37 degrees difference of Latitude, the Quotient sheweth you 101918 paces, and 1040 remaining upon the division, which is a fraction of no consequence : Therefore, if you turne 101918 Paces, into Leagues, it yieldeth 33 leagues 2 min. 918 paces. Which sheweth you, that you must sayle so much upon your course before the pole shall be depressed one degree, Now then if you repaire to my Table, which giveth the leagues upon all points of the Compasse that you must sayle, before you raise or depresse the pole one degree, and there observe which of them answereth neerest to 33 leagues 2 min. 918 paces, you will finde S. W. point Westerly, which is the point of the Compasse, which runneth right upon the Island, according to the Rombe extended betwixt the *Lyzard* and the *Barbadoes*. But you know, in sayling betwixt these two places, we haule at first a farre more Southerly course, in regard we would get as much benefit as possible of the Trade-wind (as we tearme it) which ever blovveth betvvixt the North and East, when you are neare the Tropickes, and then we haule avvay more Westerly, yet still being carefull to get into our Latitude, 50 or 60 Leagues short of the Land, that vve may be sure not to over-shoot the place :

which

which indeed is the best and surest way of sailing betwixt the afore-said places. For which manner of proceeding, we have experience, for our infallible and un-controlable Tutor, which did not dwell all his dayes within the confines of a quiet Closet; for from thence there could never as yet be drawne forth such directions. Therefore, the industrious endeavours of the judicious Practitioners in the famous Art of Navigation, must reape as in all right, the gratefull acknowledgement of their great attempts, for finding out both this and divers other matters, which no Study-Rules could ever reach so farre, to parallel their experimental Conclusions. Therefore, we may justly joyne Art and Experience, as the two equall Sisters, which made the wreath of Renowne, that bindes the Browes of all generous and worthy Navigators. But to speake a word or two more concerning the former work contained in this Chapter: You may understand, that the point of the Compasse may also bee found out, according to the distance betwixt any two places by your Meridional proportion, as we will prove by the former question, in this manner.

First, observe all the Degrees of Longitude, contained betwixt the *Lyzard* and the *Barbadoes*, and you will find they are 63 degrees, Which Degrees turne into single paces, according to each places Parallel, and there will arise in the parallel of 50 degrees 24 9721 paces, and in the parallel of 13 degrees there amounteth 36 83106 which two summes containing the single Paces according to each places parallel, adjoyne into one summe, and it will make 6112827 Paces. Now take the halfe of this last summe, which is 3056413 and it shevveth you the single paces contained in your Meridionall distance according to the Globe, therefore divide these Paces by 37 degrees, the difference of your Latitude, and the Quotient vvil yield you 82605 paces which being reduced into Leagues, doth yield 27 leagues, 1 mile, 605 paces. And now if you repaire to my former Table, and there search what Meridional distance answereth to 27 leagues 1 mile, 605 paces. You will find, that

S. W.

S. W. $\frac{1}{2}$ point Wefterly; anfwereth your defire, thus you have two infallible wayes to find out the point of the Compaffe according to all diftances; if you defire a farther reafon of this manner of work, you muft underftand it is onely drawne forth from the plain rule of Proportion in both the wayes: For as 37 degrees, the difference of Latitude, is to 3840000 Paces the diftance by the Arch, fo is one degree of the Meridian to the Courfe or point of the Compaffe, which y ielded 33 leag. 2 miles, 918 Paces which being compared in my Table S. W. $\frac{1}{2}$ point Wefterly fhewed the fame quantity, then the Meridional proportion is, as 37 deg. difference of Latitude is to 3056413 Paces diftance Meridional, fo is 1 degree of the Meridian to 82605 Paces which make 27 leag. 1 mile 605 Paces, and being compared to the Meridional diftance in my Table S, W, $\frac{1}{2}$ Wefterly, yieldeth the fame proportion, this is fufficient for thofe which defire a farther reafon of the former work, and fo I will leave this matter to their farther practice, and will now proceed to fhew the ufe and projections of the Croffe-ftaffe, and Back-ftaffe, and fo I will make a full conclufion of this my whole work.

The projection of the Croffe-ftaffe.

THe Croffe-ftaffe is onely a Geometrical Arch contrived into a ftraight line upon the graduated Staffe, which when the croffe is applyed giveth the content of the (Angle) with as much certainty and truth as the Arch or Quadrant doth, and it is projected or framed, in this manner.

You muft have a paire of beame Compaffes of a large fize, as 12, 14, or 16 Inches, with thofe Compaffes upon a plaine and exact levell board or Table, fweep an Arch of a Circle fomething bigger, then a Quadrant, and let his Semi-diameter be as bigge as with conveniencie your board or Table will contain, the bigger the better: Now with the fame extent that you fwept the Circle or portion of the Arch, fet one foot in one of the Arches extreams, and with the other

make

make a small pricke or marke in the same Arch, then take halfe the distance of those two pricks or markes, and make a third marke in the same Arch, then laying a straight ruler to the third marke at the Center, draw a straight line; and so likewise betwixt the first marke and the Center draw a straight line: so shall you have an exact Quadrant or fourth part of a Circle contained betwixt those two Semi-diameters, Now extend one of those Semi-diameters, to what length your board will permit, as 3, 4, or 5 foot, and from the intersection of the other Semi-diameter with the Arch, raise a perpendicular which may runne exactly Parallel, to the Semi-diameter extended, and make them equall of one length, then divide your Arch into two parts, drawing a Line from the Center through that division, untill it intersect the former Parallel; then divide the halfe Arch into three equall parts, drawing Lines through those divisions to the Parallel as before, and then divide those three parts into other three parts, and those 9 parts each into two parts, so have you 18 parts, and those 18 each into 5 so have you 90 parts, Now draw lines through each of those divisions, from the Center to the Parallel, as before: And so have you a Geometrical projection, for the making of all sorts of Crosse-staves according to the length of their Crosses or Transummes, onely for your more easie understanding, and that you should not mistake when you are to Graduate a Staffe by this projection observe this Method.

If you would have a large Staffe containing large Degrees, all our Transummes or Crosses must be as large as your projected quadrant is of capacity to beare, namely, the halfe of your 90 Transum may be the length of the Semi-diameter to the intersection of the Arch, but longer it must never be, for that is the greatest and largest degrees, that any Transum can shew with truth upon the largest and longest Staffe that such a projection may produce, but for the other Transummes or Crosses, namely, our 60 and 30 will have degrees large enough, if your 60 Transum be one halfe the length of your

90, and

90 and the 30 one halfe the length of the 60.

When you have a Staffe to graduate, and that you have appointed the length of his Transums according to your mind, remember always to take the exact halfe of each Transum, and draw a Parallel to your extended Semi-diameter containing that distance: And observe, how that Parallel intersecteth each line drawne through each division of the Arch, and they will be the degrees of the Angle made by your Crosse in observation, in all respects equall to the degrees of a Geometricall Arch, which is the matter desired: and is sufficiently manifested, for the capacity of any man that will be the least industrious.

Now a word or two of the reason of this Projection, and so I will proceed to shew you how to handle him at Sea, to gaine the Altitude either of Sunne or Starres: The reason of this projection may best be drawne from the Consideration of a right angled *Isoscheles*, for when your Crosse of 90 deg. intersects that degree upon the graduated Staffe, your Crosse is the subtending side or Hypothenusa, and your two visuall lines are his containing sides, namely, the Line intersecting the Horizon, and your Zenith perpendicular; and the Angle intersected by those two lines falling or ioyning with your Eye, and the Center of the Staffe, is a right Angle containing 90 Deg. Now from this I gather, if any Angle at the Center of the staffe must grow more acute or Sharpe, it must proceed by running or sliding the Crosse farther from my Eye, and not by drawing it nearer, for then I should have my Angle more obtuse or blunt then the right Angle of 90, then which, nothing can be more absurd, then to measure beyond my Zenith in taking the Altitude or Sunne or Starres, wherefore considering I must slide the Transum forwards, if I observe any body Scituated in the Heavens or lesse Altitude then my Zenith, and that my Angle from the Center of the Staffe, and my Eye, will grow more Acute or Sharpe. I perceive my right angled *Isosceles* is changed into a right angled *Scalernum*, and that my Crosse is now the perpendicular line

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falling from the Body obferved, and interfecting my vifuall
L ne with the Horizon at a Right Angle, and that my other vi-
fuall Line extended to the Body obferved, is the Subtending
fide, or *Hypotenufa* of that Angle; Therefore, I finde the Lines
drawne through an Arch exactly divided, are onely vifual Lincs
of the Angle contained, and that a Croffe may fo be fitted upon
a Staffe, to interfect each feveral vifual Line with a right angled
Scalenum, untill my vifual Lines containe a right Angle, and
the Croffe be the inbtending fide or, *Hypotenufa*, and then I
have a right angled *Ifofcheles* as afore, he that can draw forth
his Imaginations more lively concerning this matter, I freely
give him leave, &c.

How to obferve the Altitude at Sea, with the Croffe-ftaffe.

WHen you would find the Altitude of either Sunne or
Starre, by the aide of your Croffe-ftaffe, compleatly
fitted with his Tranfums, take your graduated Staffe, and one of
your Tranfums, or Croffes which is moft apt or fit for the
Altitude defired; as if it be any great Altitude, your 90 Croffe, if
a fmaller your 60 Croffe, and if the Body to be obferved be neer
the Horizon, then your 30 Croffe.

As for Example. Suppofe you were comming in for the *Sleeve*,
and would obferve the North-Starre, take your graduated
Staffe, and becaufe the Altitude is none of the greateft, imploy
your 60 Tranfum or Croffe, thrufting your Staffe through his
Socket, and then place the end of your Staffe, which is the Cen-
ter to your 90 Tranfum, in orderly fort; joyning it to the cor-
ner of your right Eye, winking with the other, then flide the
Croffe too and fro, untill you can fee onely the Center, or mid-
deft of the Starre, equall with the upper edge of your Tranfum,
and that at the fame inftant you perceive the lower equall, or
interfecting the Horizon; which when you have found in moft
exact manner, reft from farther labour: and onely looke where
the neareft plaine edge of the Croffe falleth or cutteth in your
graduated Staffe, which conclude according to the number fo
<div align="right">found</div>

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found, is the Angle contained, or Altitude of that body obser-
ved. In the same sort, you may find the Angle or Altitude of
all bodies scituated in the Heavens, with your graduated Staff,
and the Transums or Crosses rightly applied: But I hold, after
my Altitude is once greater then 60 deg. your Crosse-staffe ap-
plyed according to the former observation, is very difficult and
doubtfull to handle without great errour; because the Altitude of
the Body, and the intersection of the Horizon, are so farre di-
stant, that your visual Line, can very hardly concurre with ex-
act touch in one instant of time; therefore for the observing of
the Sunne to the South-wards your Crosse-staffe is of little use,
except you have veines, or contrive it to observe with the sha-
dow, turning your backe towards the Sunne, as you doe with
your Back-staffe, but for all Stars that are not very high above
the Horizon, especially if they exceed not 30 degrees there is
no instrument under the Heavens, to be compared with the
Crosse-staffe at Sea, because then his Degrees are so large, that
any sensible distance will easily appeare in single Minutes, and
with a little labour you shall be in no Latitude of the world, but
you shall have divers such Starres come in rule every night, if
you will make heedfull observation. Therefore the excellent o-
peration of the Crosse-staffe, can never be disparaged, if rightly
applyed.

Of the Backe-staffe.

THe Back-staffe, is onely a *Quadrant*, or fourth part of
any Circle divided into 90 Degrees, and it mattereth not
which way the accompt of Degrees beginneth to be numbred,
that is, whether your Zenith conclude 90 or the Horizon, for
they will come to one matter: if you count the Degrees con-
tayned betwixt the two sliding veines in observation, to be the
Altitude according to the cutting of the shadow, and the com-
plement, or that which remaineth without each veine, is alwayes
the Zenith distauce of the Sunne, according to the Altitude
taken, but they are commonly graduated, concluding 90 in the
Zenith, which is not the best and readiest way for the Mariners

use

ufe, but would be more eafie (though nothing difficult neither
way) if they concluded 90 in the Horizon. They are projected
of divers formes and fafhions, but the general Rule for them all,
is that they containe exactly a Quadrant, or fourth part of a
Circle, betwixt your vifual Line that interfecteth the Horizon,
and your Zenith perpendicular, but of all Back-ftaves I hold the
double Arched projection to be the beft, and moft ufefull at Sea,
therefore I will here fhew how he is framed.

The Projection of the Back-ftaffe.

THe Back-ftaffe is fo called, becaufe you turne your backe
towards the Sunne in obfervation, and your vifual Line in-
terfecting the Horizon, with the fhadow of the Sunne concur-
ring at one inftant; giveth the Angle or Altitude defired. Now
to frame the Back-ftaffe with a double Arch, take your large
Compaffes afore-mentioned, and upon fome plain board or
Table, make an exact Quadrant, as hath been formerly fhewed
in projecting the Croffe-ftaffe, containing about 6 or 8 Inches
Semi-diameter, then be very circumfpect to divide that Qua-
drant into 90 Degrees, as hath been fhewed before : Now ex-
tend your Semi-diameter, which interfecteth your Arch, where
the 90 Deg. are begun to be numbred, to two or three foot, or
at pleafure, and as your materials will permit : Then take the
length which you intend to have your Staffe, and draw a Line
from the Center, interfecting the Quadrant at 30 deg. of the
fame length, now fweep an Arch betwixt the end of that extent,
and the Semi-diameter extended, and fo your Back-ftaffe is fi-
nifhed. If you divide his 30 Arch exactly into deg. and min.
which is the Arch, whereon in obfervation you muft place your
fliding veine with the fight in it, but the other Arch needeth no
more divifions, then whole Degrees, becaufe thereon you muft
place your fixed veine, which will cut the Horizon according to
the fhadow of the Sunne, and therefore needeth but onely to
be placed at any of the whole Degrees, as occafion fhall re-
quire, and the other fliding veine convaying your vifual Line,
through the Center of the Staffe, or Horizon veine will give the

Angle

Angle or Altitude of all manner of Inſtruments at Sea that I have met withall, the moſt exaꜳ and plaine.

To find the Altitude of the Sunne at Sea, with the Back-ſtaffe.

HAving your three Veines fitted to your Staffe, namely, your Horizon veine, with a ſlit exaꜳly joyning with the Center of the Staffe, and one ſliding veine placed upon the 30 Arch of your Inſtrument, which hath a ſlit likewiſe to tranſport your viſual Line through the Horizon veine at the Center, and one plain veine placed at any of the Degrees in your 60 Arch, as your Altitude ſhall require. For example, Suppoſe you would know the Altitude of the Sunne when you are certain ſhe will be mounted upon her Meridian at leaſt 70 deg. above the Horizon. Firſt, take your projeꜳed Staffe, and put on your Horizon veine; carefully regarding, that the ſlit and the pricke at the Center concurre in one, then take your veine, and place it upon the 60 Arch, either at 70, 80, or 90, but nearer then 70 you muſt not now place it, becauſe the Angle is like to be about 70 Degrees, and if you ſhould place it at leſſe, the 30 Arch will not be capable to reſolve the Angle: therefore here in this Queſtion, ſuppoſe you place the fixed veine with his upper edge exaꜳly cutting at 80 Deg. in the 60 Arch. Then take your ſliding-veine with the ſlit in it, and place it upon the 30 Arch, moving it higher or lower as occaſion requireth, untill you find the viſual Line, tranſported through the ſlit of the Horizon-veine, and that the upper edge of your fixed-veine, caſteth his ſhadow right in the ſlit of the Horizon-veine, and that at that very inſtant your viſual Line interſeꜳeth the Horizontal Circle of the Heavens and the Sea, and ſo keep your Inſtrument, with the aide of your ſliding-veine, untill you have the Sunne upon the Meridian, or greateſt Altitude, for that day, then obſerve in your 30 Arch, what Degree and minute the ſlit in your ſliding-veine cutteth, and accompt all the Degrees contained from the upper edge of your fixed-veine to that interſeꜳion: For the true Content of the Angle, according to the Altitude

of

of the Sunne taken that day in the afore-said place; As in this Example. Admit after the staffe rectified in all respects as before, that the Sun upon her Meridian, your sliding-vein cutteth with his slit just in 10 Deg, of the 30 Arch, therefore you must accompt from the upper edge of the fixed-veine, placed at 80 Deg. to ten Deg. the former intersection, and it will yield you 70 Degrees. which you may safely conclude, is the Angle or Altitude desired.

And so I will conclude the whole Worke herein contained, beginning with the Practicke part of Navigation, in working a Ship according to all weathers, and ending with the Practicke in Projecting and using the Back-staffe: Desiring that none out of malice, will seeme over-suddenly to take in hand to mend the matter which I have now writ of, least they shoot short of the Marke, and so loose their Credit by controlling, when they are not able to performe the like.

And so Farewell.

F I N I S.

The Names of such Books as are

Printed and sold by *George Hurlock*, at *Magnus* Church-corner.

The Sea-mans Kalendar.

Nortons Art of Tens, or Decimal Arithmetick, 40.

Safeguard of Saylers, or great Rutter, by *Robert Norman*.

A Table of Gauging all manner of Vessels; by *John Goodwin*, 80.

Path-way to perfect sailing, by *Richard Polter*, 40.

Pitiscus his Doctrine of Triangles, with a Canon of natural Sines, Tangents, and Secants.

Norwoods Doctrine of Triangles, with Logaritmes.

Norwoods Epitomy, applyed to plain and Mercators sailing.

Norwoods Sea-mans Practice.

The Navigator, by Captain *Charles Saltonstal*, 40.

Dary's description and use of a Universal Quadrant, 80.

Sea-mans Dictionary, or the demonstration of all the parts and things belonging to a Ship, together with an explanation of all the terms, and phrases used in the practique part of Navigation, by Sir *Henry Manwayring*, 40.

A Mathematical Institution, shewing the Construction and use of the Natural and Artificial Sines, Tangents, and Secants, in Decimal Numbers, and also of the Table of Logarithmes, in the general solution of any Triangle, whether plain or Spherical, and the application in Astronomy, Dialling, and Navigaon, by *John Newton*, 12

The Sea-mans secrets.

A Prayer Book for Sea-men, by *Thomas Reeve*, Preacher of of Gods Word.

The Sea-mans Glasse, shewing the use of the plain Scale in Astronomy and Navigation.

The Compleat Canoneer, or Gunners guide, shewing the chiefe principles, or grounds of the whole Art of Gunnery, As also serviceable fire-works both for Sea and Land.

The

The Advancement of the Art of Navigation, shewing by a new Cannon of Sines Tangents and Sea.cants, how to resolve all Cases of right Lined Triangles only by looking into the Tables, Applyed to all the three kinds of sayling. *viz*. By the plain Chart, by *Mercators* Chart, and by a great Circle, and to the Art of Surveying, with many observations for the better ordering of the long line; And for the more Exact and ready measuring, not only minutes but second of time: And new Experiments for the more constant finding the Ships way.

There is now in the Press an excellent Canon *Trigonometrical* in *folio*, exhibiting the Logarithms of all numbers from one to a hundred thousand, in a large Figure and but a few sheets, the Sines and Tangents to the hundredth part of a degree, the three first degrees to a thousand parts, with M. *Gellibrands* Doctrine of Triangles faithfully translated from the Latin Copy: and another Institution, shewing the construction of both the Canons in a more compendious manner, then hath been hithero published in the English Tongue, The which will be publique in Hilary Terme.

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